creative computing

Jul - Aug 1977
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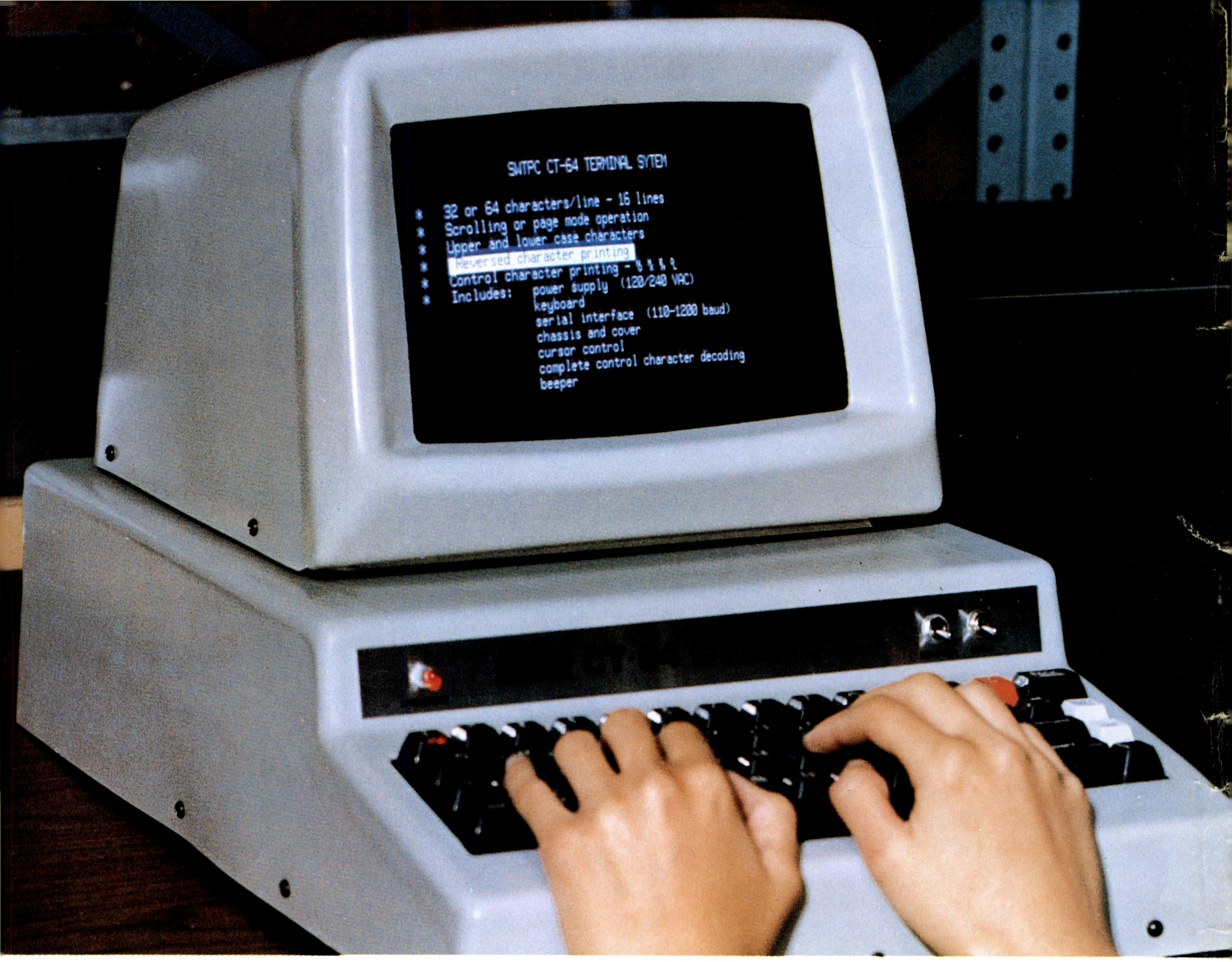

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SWTPC CT-64 TERMINAL SYTEM

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*   Scrolling or page mode operation
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*   Includes:   power supply  (120/240 VAC)
                keyboard
                serial interface  (110-1200 baud)
                chassis and cover
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                complete control character decoding
                beeper
```

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- Premium display with both upper and lower case letters, and descenders (g, j, etc.)
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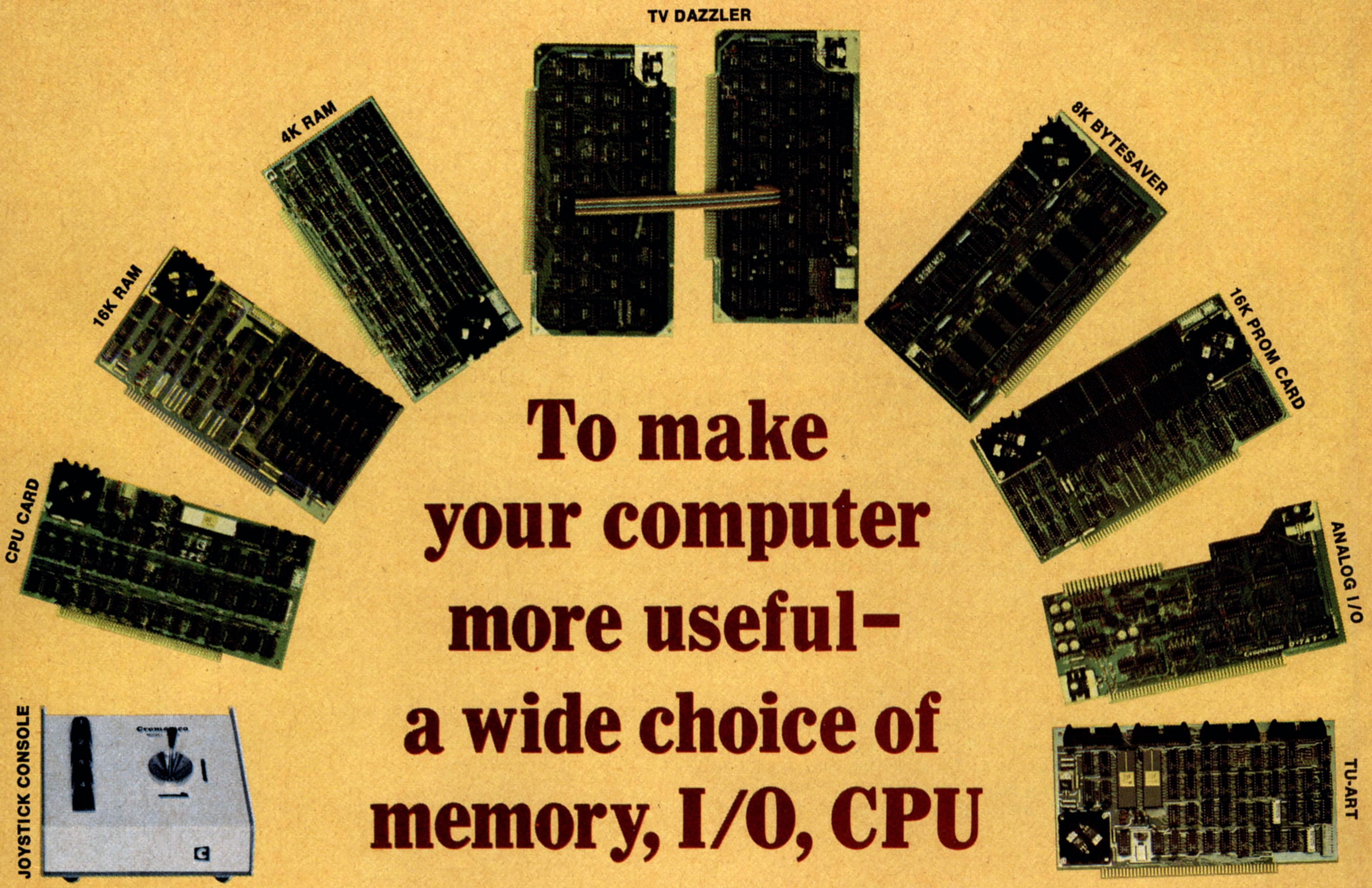

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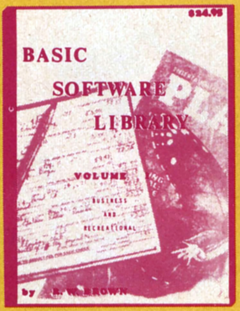
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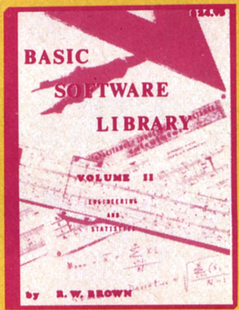
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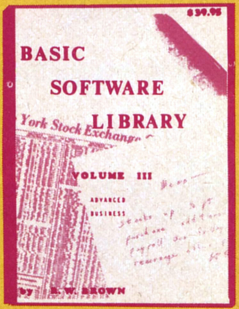
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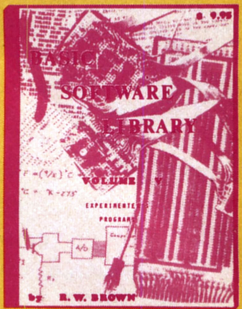
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in this issue . . .

22 **The West Coast Computer Faire** . . . . Ahl
Hardware, interviews at the San Francisco Show.

31 **Selecting a Micro** . . . . Gray
The basic types, and what they can do for you.

34 **Psychiatric Assessment via Computers** . Hastings
Self-report testing at a VA hospital.

36 **Heath: Two Computers and Two Peripherals** Gray
And that's just for openers in this new line.

37 **Felsenstein on SOL** . . . . Ahl
An interview with the designer of the SOL CPU.

40 **A New Generation of Biomedical Instruments** Brus
Four microprocessor-controlled devices.

41 **The Miraculous Medical Microprocessor** Weintraub
A look into the future: space, bionics, cryonics.

43 **Two Space Games (With Graphics!)** . . . . North
Review and evaluation of SPACEWAR and TREK 80.

46 **BASIC and the Personal Computer** . . . . Dwyer
First part of a tutorial series on this language.

62 **CAI: Structuring the Lesson to the Student** . . . Ahl
How to tailor problem types and difficulty.

65 **The NEW Creative Computing Catalog**
Hot off the press, for your edification and delight.

creative computing

Jul-Aug 1977 Volume 3, Number 4 Consecutive Issue No. 16

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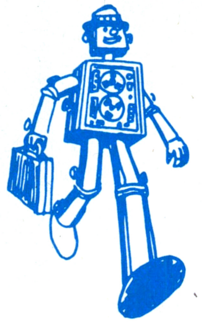
87 **Thinking Strategies With the Computer** . . . .
Piele & Wood
How to break a problem into simpler subproblems.

91 **The Case of the Reader Uncovered** . . . . Green
Creative Computing readership survey analysis.

96 **A Taste of APL** . . . . Finseth
Just enough to give a "flavor" of the language.

100 **ELIZA** . . . . North
Psychoanalysis (?) by computer, with listing.

106 **Sherlock Holmes and Charles Babbage** . . . . Earlson
Closing part of a highly imaginative fiction.



ARTICLES

The Second Trenton Computer Festival — Gray 28
Computers and Medicine — Hastings 30
Computerized Robots for Hospitals — Armstrong 45
Computers in Research — Hammer 56
Supertoys for Learning Mathematics 58
You and the Computer — Spangle 61
Creative Computing Compendium 126

FICTION AND FOOLISHNESS

The New Game — Ledger 118
Marsport — Sonntag 130

REVIEW AND RESOURCES

Compleat Computer Catalog 12
Retail Computer Stores 122

THINGS TO DO—COMPUTER GAMES

Puzzles and Problems 81
The Loan Arranger — Warden 104
Computer Games:
  BACKGAMMON 132
  BOCCE 135
  UFO 141
Anamorphic Art — Zucker 137

DEPARTMENTS

Notices 4
Input/Output 9
Editorial 6
Reviews 114

THE COVER

Hearing a strange whirring sound one day, I ran outside to investigate. Imagine my surprise when I saw a robot, seemingly made of Lego blocks, emerging from our garden. I quickly snapped a photo and then went to tell my kids, but when we returned, nothing was there but a few drops of oil! Weird.—DHA

MERLIN

THE INTELLIGENT VIDEO INTERFACE

MERLIN is the best ASCII/Graphics board now available for the S-100 bus . . . and at an unbelievable price!

Compare these features to any other video interface:

☆ 160H x 100V resolution bit mapping graphics
☆ On-board ROM (Monitor/Editor) option
☆ 40 characters by 20 lines, character ROM generated (hardware)
☆ Keyboard interface (with power)
☆ Programmable modes and display format
☆ Serial I/O port
☆ Low power . . . only 600ma at +8V
☆ Extremely fast (uses DMA)
☆ Comprehensive User Manual . . . 200ps
☆ American 60HZ or European 50 HZ operation.

Designed-in expandability means maximum versitility at minimum cost. Add-on options now available (in kit form) include:

☆ Super Dense Graphics (M320-K) $39
☆ Lower case characters (LC) $25
☆ Serial-to-parallel expansion Kit (MSEK-K) $45
☆ 1500 Baud (software) cassette interface kit (MCAS-K) $29
☆ 2K x 8 Mask ROM; graphics, cassette, & extended editing software (MEI) $35
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The MBI ROM software is designed to allow turnkey operation and sophisticated editing and scrolling.

Ask to see a demonstration of MERLIN at your nearest computer store. Many dealers now stock MERLIN and there is nothing like a hands-on demo for really evaluating a product. We know you'll be sold.

MERLIN Kit with Manual $269
MERLIN, assm'd & tested $349
MERLIN User Manual . . . . $ 10

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ces...notices.

THE Personal Computing Fair '77

Oh joyous day! The fun, frolic, merchandise, information, ideas, presentation of new products, sharing of dynamite workshops is to happen again this year. It wasn't just a once in a lifetime. For the thousands of you who attended last year—yes, the Personal Computing Fair is again scheduled for the last weekend of August in Atlantic City. For anyone who missed this two-day spectacle of computer hobby enthusiasts milling around the packed exhibit area trying to catch all the new products, scribbling notes at the workshops, meeting friends, don't miss it this time around.

The "Computer Hobbyist of the Year" Award will be presented again this year and the selection board is seeking nominations. The person you choose should be an amateur, not someone who's employed in the field, and should be the kind of person who goes out of the way to support and help other hobbyists, whose efforts have benefitted hobby computing. Think about who you'd like. Nominations are welcomed from either individuals or clubs.

Twenty-five homebrew systems will be chosen for display and the three best of these will be awarded big prizes. Send information about the system you'd like to enter, but do it soon. The competition will be keen.

Creative Computing will be at the fair, at booths 129 and 130. Publisher Dave Ahl and editor Steve Gray will be giving talks. For specifics on who else will be there, look in this issue for the PC-77 ads. Meet you August 27-28 in Atlantic City, N.J.

John H. Dilks, Fair Director, Personal Computing 77, Rt. 1, Box 242, Mays Landing, NJ 08330.

IFIP Congress 77

IFIP Congress 77 marks the first return to North America in more than 12 years for this triennial gathering of the foremost information scientists from around the world. The Congress, to be held in the Sheraton Center, Toronto, Canada, the week of August 8-12, offers an information exchange with developers and users of the most advanced computer techniques from some 35 countries. An impressive technical program has been planned.

Meet Creative Computing at booth 136. Robert Spieker, Registration Chairman, U.S. Committee for IFIP Congress 77, c/o A T &T, 444 Hoes Lane, Piscataway, N.J. 08854. (201) 463-2200.

Call For Games

Creative Computing is always looking for new and original games, simulations and applications. If you would like the thrill of seeing your own program in the pages of *Creative Computing,* please send it to us. But before doing a LIST and RUN please put a new ribbon in your printer, along with white paper (or turn the green-and-white paper over).

ACM Sponsors National Student Programming Contest

The First Annual National ACM/UPE Student Programming Championship contest took place February 2, 1977 in connection with the Computer Science Conference in Atlanta, Georgia. The contest was sponsored jointly by the ACM Committee on Student Chapters and Memberships and Upsilon Pi Epsilon (National Computer Science Honor Society.) Teams participated from 16 colleges and universities.

The contest was conducted over a seven-hour period. The teams were given four problems to solve using ANSI FORTRAN, consisting of: 1) a conversion from Roman to Arabic numerals, 2) a character manipulation for re-arranging of names and title, 3) the determination of amicable numbers and 4) the automatic scoring of the game of bowling. The winners were determined by penalty points and the elapsed time taken for each problem. Although many teams were close on several solutions, only four teams completed three of the problems.

The National Champion Team is Michigan State University, who also won their Regional competition. Second place went to Purdue University, third place to the University of Missouri at Rolla, and the fourth place to Georgia Tech. Trophies and certificates were presented to the participants at an Awards Banquet.

Plans have been made to make this an annual event in connection with the ACM Computer Science Conference. In 1978 it will take place on February 22 at the Plaza Hotel in Detroit, Michigan. Regional contests will be scheduled for the Fall of 1977 to qualify teams to compete in the National Contest. Teams and sponsors for these qualifying regional contests are now being solicited from all regions within ACM. Persons interested in participating or holding such a contest should contact: Dr. J. Richard Newman, Academic Computing Services, *Southern Illinois* University, Carbondale, IL 62901, (618) 536-2323.

News! News!

Creative Computing has a new toll-free number, to make it easy for you to subscribe, renew your subscription, or to order a gift subscription for a friend. Call Linda at 800-631-8112.

Simulation and Gaming

The 16th Annual Conference of the North American Simulation and Gaming Association will be held at the Park Plaza Hotel in Boston, MA, October 11-14. The conference theme is "Adult and Continuing Education in Simulation and Gaming."

Contact: N.A.S.A.G.A., c/o Barry R. Lawson, Room 205, Metropolitan College, Boston University, 755 Commonwealth Ave., Boston, MA 02215.

World Game '77

The eighth annual World Game Workshop will be held this summer in Philadelphia at the University of Pennsylvania in conjunction with the University City Science Center, The Franklin Institute, International House, and Buckminster Fuller.

Energy, food and resource shortages, environmental degredatio, widespread poverty and political and economic instability reflect the ineffectiveness of existing policies and institutions to cope with global problems. The need for wholistic and humane methods for recognizing and solving problems has sparked an explosion of public interest in more interdisciplinary approaches that do not view crises as isolated phenomena but as interrelated symptoms of larger systemic dysfunctions.

"World Game" is a metaphor used to describe the design and planning of ever more effective and considerate ways of using the world's resources. The World Game Workshops are based on the view that the coming decades are a transitional period in which choices need to be made regarding the common futures of al humanity. This year's workshop, World Game '77, will be produced by Earth Metabolic Design, Inc. and it will consist of two programs: The Planetary Planning Symposium and The Design Science Laboratory.

The Planetary Planning Symposium will be a one-week schedule of morning and evening lectures with alternative afternoon seminars on various topics related to the concept of comprehensive long-range planning. The lecture series will feature distinguished scientists and humanists who will present their viewpoints and theories concerning critical world-wide problems and their possible solutions.

The second phase of World Game '77 will be called a Design Science Laboratory. It has been organized as a six-week internship program for individuals who want to develop skills in environmental design, appropriate technology, energy policy and resource planning by working closely with experts on the forefront of these and related fields.

The World Game Workshops, initiated by Buckminster Fuller, have produced new global strategies for generating and distributing energy *without* the use of petroleum or nuclear fuels (published as *Energy Earth And Everyone* 1975/Straight Arrow) and plans for feasible global food abundance (soon to be published as *Food For Everyone.*) The purpose of the entire program is to explore and design alternatives for better meeting the life-support needs of all humanity and although the workshops have attracted a wide range of professional researchers, designers and planners from around the world, they are primarily designed as educational experiences for the public. Tuition for the Planetary Planning Symposium is $200 and tuition for the extended Design Science Laboratory program is $150. For more detailed information contact Frank Mclaughlin, Coordinator, World Game '77, 3500 Market St., Philadelphia, PA 19104, (215) 387-2255 ext. 226.

Personal Computing Expo, New York

A trade and public show, Personal Computing Expo, featuring the latest developments and equipment in hobby computers, is scheduled to be held October 28-30 at the New York Coliseum.

Over 250 exhibitors are expected to show their products, and Byte magazine will provide speakers, as well as experts for the seminars. Leading manufacturers have been invited to explain their microcomputer systems. Seminars and lectures are free to visitors.

Our publisher, Dave Ahl, will speak on applications of microprocessors.

Our Face is Red

Due to publishing delays, the address reported for the PILOT in the May-June issue is incorrect. Please direct your correspondence to:

Pilot Information Exchange
c/o Gregory Yob
PO Box 354
Palo Alto, Calif. 94301

News! News!

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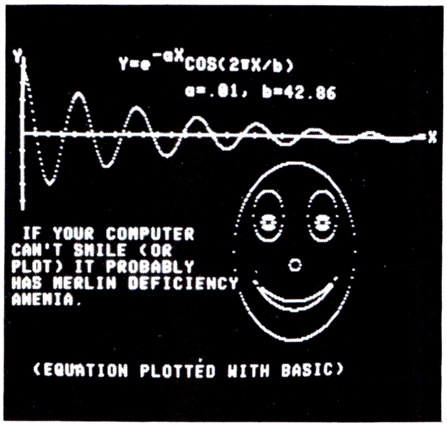
SUPER DENSE GRAPHICS

320 Horizontal by 200 Vertical


Y
Y=e^-aX COS(2πX/b)
a=.01, b=42.86
X
IF YOUR COMPUTER CAN'T SMILE (OR PLOT) IT PROBABLY HAS MERLIN DEFICIENCY AMENIA.
(EQUATION PLOTTED WITH BASIC)

The MERLIN Super Dense add-on kit provides maximum resolution at a minimum cost. In fact, MERLIN with Super Dense has more capabilities than any other S-100 bus video interface at any price!

Once you've seen 'Super Dense' graphic resolution you'll know there is nothing to compare it to . . . short of spending over $600 . . . and even then you'll not have all of the capabilities of MERLIN with 'Super Dense'.

Super Dense provides true bit-mapping. Each and every point on the screen is controlled directly by a bit in memory. (Requires 8K of system memory.)

ROM character-graphics looked good for a while; then came MERLIN's 160 by 100 bit mapping graphics; and now . . .
320 by 200 bit-mapping graphics! ! !
If you're looking for a graphic display, MERLIN with Super Dense is the best there is. And if you hadn't considered graphics or thought it was out of your price range, consider what you could do with 320 H by 200V graphics and for only $39 extra.

The Super Dense add-on kit to the popular MERLIN video interface is now available with off-the-shelf delivery.
M320-K, Super Dense Kit $39
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See MERLIN ad on previous page.

For information fast, write direct, or see 'Super Dense' at your nearest computer store.
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Hobby-computer manufactures and magazines are making a lot of noise about all the wonderful things you can do with a computer in our home.

To be sure, anything that can be done with a personal computer, somebody will do. The question is, how many people will actually do it? Take any of the lists of applications that are becoming increasingly prevalent, and you'll find only a handful that will be implemented by more than a few—by that hardy band of experimenters, hardware fans, and computerniks. And as more and more people who know less and less about hardware or software get into hobby computing, the "real" list of applications will shrink drastically.

Let's take a look at some of the proposed applications. On every list you'll find burglar alarms. Sure, you can hook up a computer to tell you if a window or door has been opened. That means running a wire all through the house, with a pair of contacts at every door and window that a burglar might use. Then you hook up the computer to let you know if the circuit is broken, and you leave the computer on all night. For a few dollars, you could do the same job with a relay, buzzer and batteries. And not tie up your computer for hours and hours.

To make real use of a computer in a burglar-alarm system, you could set it up to tell you *which* door or window the burglar used. This involves installing, at each place of entry, a microcircuit that transmits an individually coded signal to the computer to identify which way the burglar came in. But, as the burglar comes up your stairway, with a cigarette lighter in one hand and a blowtorch in the other, intent on toasting the soles of your feet to make you tell where you hid the money you don't want the IRS to know about, does it really make a difference how he got in? By the time you've decoded the 11010 signal, and determined from your code list that he came in through the cellar door, he may already be lighting up. What good is your computer-derived knowledge then?

Pantry inventory is on many lists. Sounds interesting and even worthwhile. But when you get right down to figuring out what this involves, will you actually carry through? You'll need a whole grid of normally-open contacts, one to put under each box on the pantry shelf, so that when a box is removed, the computer records that this box of cereal or sugar or raisins will have to be reordered. Of course, you'll need some sort of timer in the system, because the box may not have been taken off the shelf permanently, but only for a meal, or for a recipe. And each set of contacts will have to be coded somehow, to identify what is where. Sure, it can be done, but will *you* do it? How much easier, and cheaper, for the housewife to jot down, on one of those handy printed lists that grocery stores provide, that you're out of sugar, or raisins, or caviar.

And so it goes, with many applications that at first seem attractive, but which require more hardwire and more wiring-up time than most of us would bother with. A great many of applications are much more easily handled with a calculator, or an inexpensive electronic (or electric) device tailored to the job, or just a deck of three-by-five file cards.

Three areas of applications will get a big play. The first, of course, is recreation, mainly games and graphics. The second is education, using the computer to teach your children math and other subjects, for instance.

The third area will probably outgrow all other types of applications: business uses. Many computer stores are now working up systems for drugstores, dentists, doctors, small companies, etc., for accounting, customer files, inventory control, mailing lists, and so on. Even if the *hobby*-computer market doesn't get saturated (some have predicted this could happen as early as the end of 1977), business applications stand a good chance of growing at a faster rate than all other uses. And if satisfactory means of service and support for business installations can be worked out, purely hobby uses of microcomputers could end up in second place.

Stephen B. Gray

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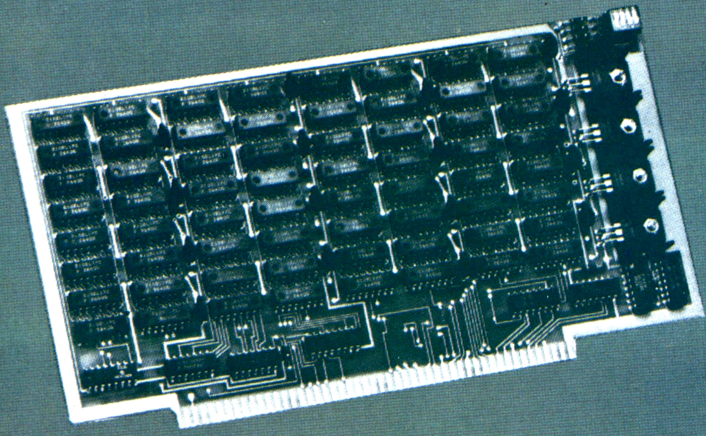

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Keith L. Doty

This book provides a complete basis for exploring the dynamic field of microcomputer systems and applications. After a general overview of the microcomputer scene, the author illustrates how general computation is a form of accounting with a decision-making capability. After developing confidence in the power of these existing devices, he proceeds to develop the notion of information and its representation as is seen by the computer and the programmer. No prior programming knowledge is assumed and elementary material on programming is presented.

2^{10} QUESTIONS AND ANSWERS ABOUT HOME COMPUTERS

Richard L. Didday

A book for the person interested in microcomputers who wants to get an idea of what it can be like before buying the equipment and for the person with a microcomputer who wants ideas for things to do, help in reading the literature, help in deciding what ways to go.

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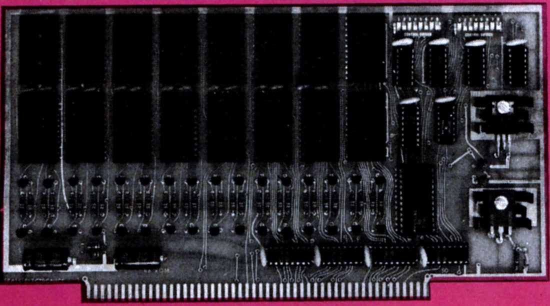

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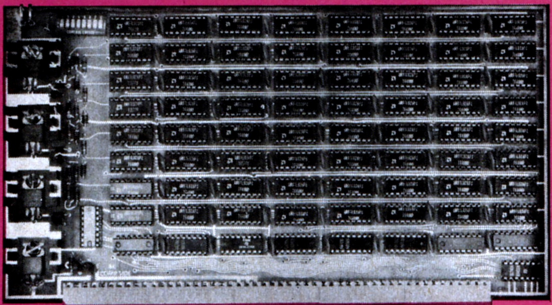

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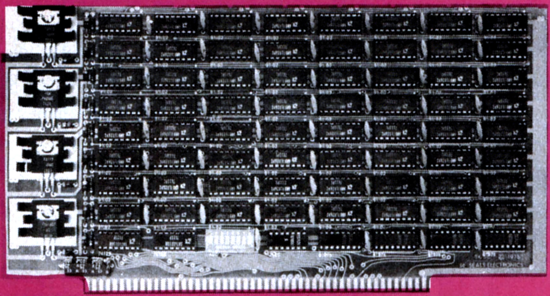

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Corrupting Youth With COBOL

Dear Editor:

I would like to comment on Tom Allen's "Algorithmic Basic" (March-April 77 *Creative Computing).* I agree that BASIC is a very restrictive vehicle for the communication of algorithms, but I believe it would be a disservice to your readers to adopt Allen's COBOL-isms. I myself believe that the structure of a program is made clearest by a pseudo-Algol format. The statement-grouping ability of Algol allows one to discern program structure at a glance without using an excessive number of procedures. A printed page is two-dimensional and Algol can be written so as to take advantage of both dimensions to depict structure. Please do not corrupt the minds of the youth of America (as well as encouraging writer's cramp) by teaching them to think in COBOL.

Professor Alan Filipski
Department of Mathematics
Central Michigan University
Mt. Pleasant, MI 48859

Microdata Reality

Dear Editor:

Microdata Reality: Are there any other computer hobbyists using this sytem? if so, I'd like to say hello, swap notes and programs, etc. Would also like to know where to buy a 4- or 8-way video terminal interface card and other peripherals for Microdata Reality (Model 1600 cpu).

Jack Hardman
140 Forest Ave.
Glen Ridge, NJ 07028
(201) 429-8880

Communicating With a PDP-8

Dear Editor:

Your magazine is really great. The problem I have with it is this: The articles and advertisements make me feel that a better way of communicating with our 5 PDP-8/L's than through the TTY ASR 33 can be ours and that this better way should not cost very much.

I know you and I discussed the problem of loading the processors quickly and cheaply in the past when you were with Digital. It always seems that some expensive peice of interfacing is needed to tie some inexpensive fast loader to the processor.

Take for example the reader that works by pulling the paper tape through it, which costs $95. Where would I find information to interface this reader to the PDP-8/L's?

I have been directed to DEC and naturally they want the price of another processor to interface the reader. Are there some manuals, books, etc. that I could purchase that would enable me to build an interface that would be compatable to both the PDP-8/L and the reader?

John G. Boyce
Wm. Tenncut Sr. High School
Warminster, PA 18974

Pub. Note: Actually it's not clear that there is a better or lower cost device than the ASR33 Teletype for getting data in and out of a computer. The problem that most hobbyists have of course, is that they simply can't afford an ASR33. Consequently they come up with all kinds of other schemes such as optical paper-tape readers, bar-code optical lightpen devices and other similar tricks to get data in and out of their hobbyist microcomputers. Indeed, even with my own four systems at home it was not until just recently, when Dartmouth sold some of their older Teletypes that I finally got my own ASR33. Prior to that I had been using a conglomeration of other homebrew methods. All of them, I might add not as satisfactory as the ASR33.

On the other hand I can certainly see some justification for interfacing various I/O devices, particularly some of the more novel ones that are being brought out for the home computer user to mini computers. In particular I'm thinking of the $300 speech synthesizer recently announced by AI Cybernetics Corp or the music synthesizer recently announced by some outfit in California. However, as you and I both well know, DEC doesn't encourage this sort of thing and generally puts up the smoke screen that you'll void the guarantee or that it can't be done or tries to charge you an arm and a leg for doing such "unusual" interfacing. They have a point, since they are, of course, responsible for maintaining their hardware and probably don't want people poking around inside doing all kinds of strange things that their diagnostics won't show up the next time the computer goes down.

Right now I don't see any simple solution. However, I do see coming in the not too far distant future a confluence of the minicomputer and microcomputer movement. In other words, I expect to see more homebrew devices designed to be hooked up to minicomputers. We're certainly seeing that with the LSI-11 right now as hobbyists at the high price end are beginning to be able to afford an LSI-11. With time I believe that we'll see more devices for other minis. Perhaps PDP-8's, although at the moment PDP-8's are not widely available to the hobbyists and still command a fairly high price on the used computer market.

Help Needed on PDP-8 System

Dear Editor:

We need help, more specifically an education! We presently own a PDP-8/E, with 20K, dual DEC tapes and four Teletypes. We need to find a source of clearly written directions or information that will allow *us* to do the following without hiring a specialist:

1. Choose the right modems which will allow us to move a Teletype around the school and use the school two-digit phones (or any phone system).
2. Hook up the modems correctly.
3. Decide whether we can interface an inexpensive floppy disk to the system, how to do it, and what parameters and ramifications we must face.
4. Decide whether we can interface other inexpensive peripherals shown in *Creative Computing* to our system.
5. Write handlers for peripherals.

There seems to be too much expense involved if we go through DEC. We have the programming ability and the mechanical ability, but it ends there.

We would appreciate any help you could give us. Thanks for your cooperation.

Richard A. Brown
Instructional Computing Director
Minnechaug Regional High School
621 Main Street
Wilbraham, MA 01095

Translation Problems

CREATIVE
COMPUTING

DEAR EDITOR

I enjoy reading *Creative Computing* but I have to translate before using your applications. I have the use of an IBM System/3 Mod 10 Card/Disk Input System, with COBOL and RPG II Compilers. For my computer-assisted instruction program, I use an assembler subroutine to accept a one-byte entry from the console panel.

Do any other readers have the same translation problems? Would they be interested in COBOL or RPG II versions?

Robert Price
Allegany County Vocational Technical Center
PO Box 5387
Cresaptown, Maryland 21502

An Amazing Computer System

Dear Editor:

Imagine the following computer system available at a high school:

Hardware: 1000-card-per-minute card reader, disk drives, tape drives, 600-page-line-per-minute printer, the equivalent of 128K bytes of storage, hardware multiply, divide and floating-point arithmetic, indirect addressing, 6 levels of interrupts, a data channel.

Programming languages available: Fortran (3 different compilers), Basic, RPG, Cobol, a PL/1 subset, Algol 60 with dynamic storage allocation, an assembler, a student language assembler, APL, CSMP.

Operating system: a system which with two control cards will compile, load and run a Fortran program, automatically allocating scratch disk files if needed, which can automatically add modules to the system library and remove them at the end of a job, which almost anyone can run because once it is started the only controls that need pressing are the stop and start keys on the card reader, which has sufficient power, however, to allow huge programs with many modules sharing storage to be run (e.g., student-written compilers; simulations of subway systems, telephone networks, kidneys, rockets; games that play 20 questions (the computer guesses and learns), make mazes, play dots, etc.

What is this amazing machine? The IBM 1130!

Our school has a 300-card-per-minute reader and an 80-line-per-minute printer, both slow enough to keep the administration away from doing paperwork with the computer leaving it exclusively for instruction. We use most of the software listed especially Fortran IV, the assemblers, Algol, APL and CSMP.

I doubt that there is another machine in the price range ($70,000) which has software as varied or as well-documented as that available for the 1130. Our only complaint is that the 1130 is a bit slow, but the average student job runs in less than a minute, with an average turnaround of less than 5 minutes—much less.

Jim Berlin
167-01 Gothic Drive
Jamaica, NY 11432

P.S. Some features and programs are not directly available from IBM, but come from other vendors.

Music Dream Machines

To the Editor:

I hope your readers were not misled by some of the statements in the article "Music Dream Machines: New Realities for Computer-Based Musical Instruction" in your March-April 1977 issue. The article incorrectly identified Professor David Peters as head of the PLATO music project at the University of Illinois. In fact, Sherwin Gooch, inventor of the Gooch Synthetic Woodwind (which is pictured in the article and described as a four-voice synthesizer) is the head of the PLATO Music Group at the Computer-Based Education Research Laboratory. Professor David Peters of the University of Illinois. Music Department has been and is active in developing music courseware that utilizes the GSW, its related software, and PLATO. He directs the University of Illinois Music Department's PLATO music effort.

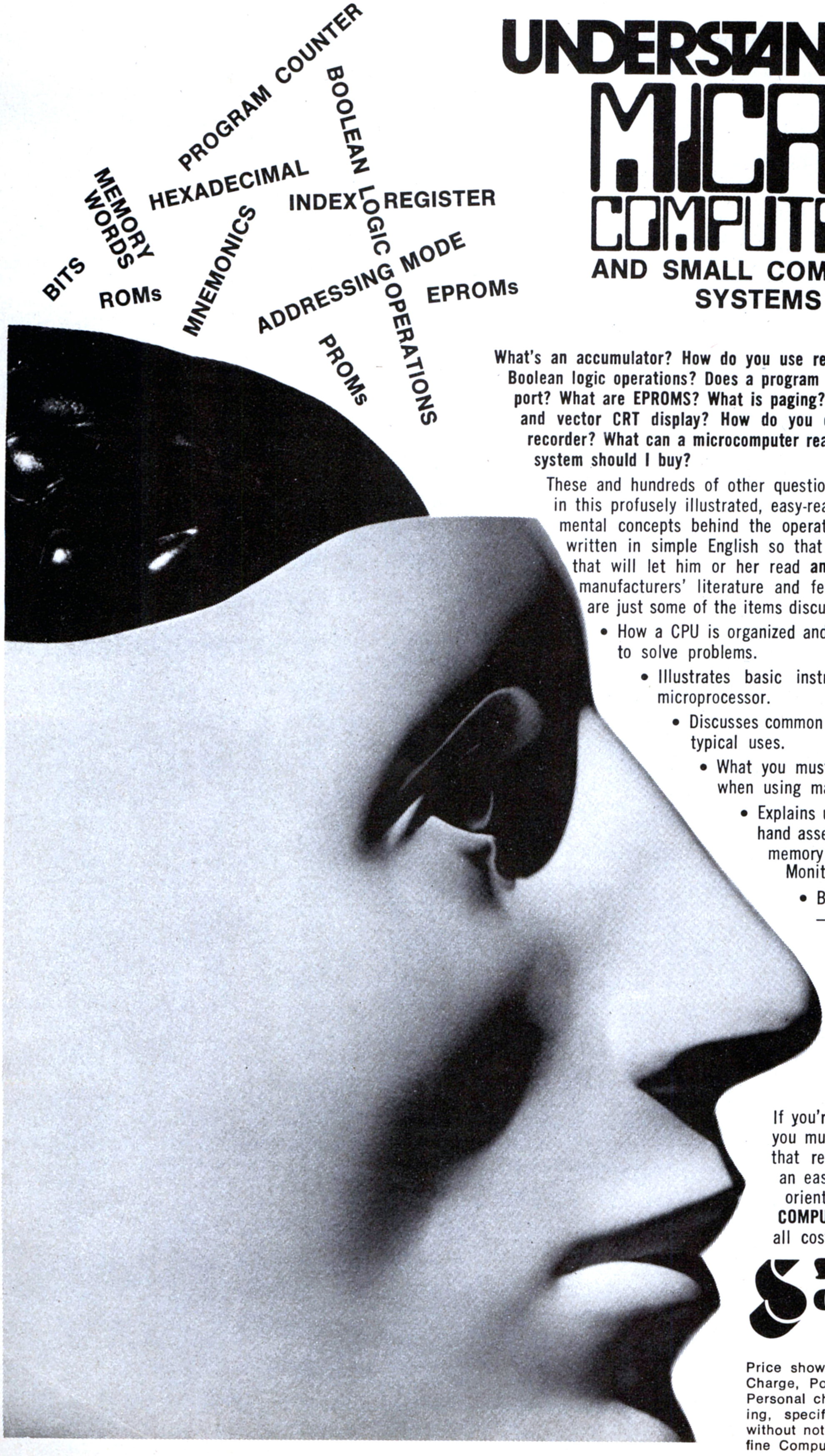
The GSW, sometimes informally referred to as the "PLATO-IV Music Box," is a low-cost device which produces music from instructions transmitted to it through a PLATO-IV student terminal. It has four voices, each of which can be playing a different tone at a different volume. Each "voice" has the capability of playing notes from the lowest note on a piano to frequencies above the human hearing range.

The GSW System, which was developed by Mr. Gooch at the University of Illinois, has been used successfully for entertainment, learning music intervals and notation systems, and even for learning Morse code. It can also be used as an aid to composition, and in fact, the day that some have dreamed about is already here. Malcolm Wright in his article "New Horizons for Microcomputer Music" looks to the day when a composer will be able to "write and edit pieces of music for a whole orchestra and (be) able to play the music instantly after completion by typing RUN on his computer." With the GSW music system, a composer can today write and edit a piece and hear it within a number of seconds. The hardware to implement this capability with orchestral pieces is currently being developed. In addition to all this, when coupled with the interactive power of the TUTOR programming language, the GSW system can be used as an interactive art medium.

When used in conjunction with the microprocessor-controlled PLATO-V terminal, designed by Jack Stifle and known as the Programmable PLATO Terminal (PPT), the GSW System can accept polyphonic musical input from a piano-like music keyboard. The next level of development, currently in progress, known as the Gooch Cybernetic Synthesizer, will be a 16-voice computer-controlled synthesizer with timbre, volume and envelope shaping of each voice under computer control.

Tina Gunsalus
Computer-Based Education Research Lab.
University of Illinois

The book you've waited for is here!



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- Benefits of using a high level language — introduction to BASIC.
- How a computer communicates. Types of commonly used input/output devices and their operational concepts.
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If you're at all curious about small computers, you must own this 300 page no-nonsense text that reads like a simple book, and includes an easy-to-use glossary of key microcomputer oriented words. **UNDERSTANDING MICROCOMPUTERS.** The name says it all. And, it all costs only $9.95. Order your copy today!

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We welcome entries from readers for the "Compleat Computer Catalogue" on any item related, even distantly, to computers. Please include the name of the item, a brief evaluative description, price, and complete source data. If it is an item you obtained over one year ago, please check with the source to make sure it is still available at the quoted price.

Send contributions to "The Compleat Computer Catalogue," *Creative Computing,* P.O. Box 789-M, Morristown, NJ 07960.

BOOKS AND BOOKLETS

DESIGN YOUR OWN GAME

The second edition of *Design Your Own Game* has been published by Harvard W. McLean and Michael J. Raymond, two Ohio educators. This 94-page soft-cover book goes into both simulation and instructional games, and has chapters on selecting formats, objectives, limiting factors and interaction sequences in the model, rules, evaluation, writing a manual for the game, etc. The existing games of each type are presented and modified. The last pages provide helpful directories of simulations and games, organizations, periodicals, and companies and catalogs. $3.95.

The Simulation and Gaming Association, 4833 Greentree Road, Lebanon, OH 45036.

PERIODICAL GUIDE

The *Periodical Guide for Computerists 1976* is a 20-page index to articles from 15 magazines read by computer hobbyists. The magazine include *Creative Computing, Byte, Dr. Dobbs Journal, SSCS Interface, Interface Age, Popular Electronics, Radio Electronics, PCC, 73, Electronics, EDN, Electronic Design, Digital Design,* and the ill-fated *Microtrek.* Over 100 subject headings are used with more than 1,000 articles, book reviews, letters and editorials. $2.50.

E. Berg Publications, 1360 W.S. 199 Ct., Aloha, OR 97005.

UNDERGROUND BUYING GUIDE

The *Underground Buying Guide for Hams, CBers, Experimenters and Computer Hobbists* lists over 600 sources that cater to the electronics hobbyist. The first section contains an alphabetical listing of firms, capsule descriptions of their offerings, prices, complete addresses and phone numbers.

The second section contains 200 categories of parts, services, etc., with a cross-reference to the first section. The third section is a geographical cross-reference.

We hope most of the listings are more accurate than those for *Creative Computing* and *Byte.* The *Creative* listing in Section 1 mentions only books (and none of our own) and ignores the magazine. *Byte's* listing in Section 1 is OK, but in Section 2 *Byte* is cross-referenced under books, not magazines; *Creative* is not cross-referenced at all in Section 2. We checked about two dozen hardware manufacturer listings and found them generally accurate. The biggest problem is omissions in a fast-moving field; obvious ones we spotted included TDL, ECL, North Star, and Ximedia.

Despite the Criticism, there's nothing else like it and you may find it a worthwhile investment. $5.95 postpaid from PMS Publishing Co., 20440 Town Center Lane, Cupertino, Cupertino, CA 95014. Or order direct from *Creative Computing.* Same price.

PROGRAM ABSTRACT DATA BASE

The National Computer Program Abstract Service (NCPAS) has 25,000 abstracts in its data base, said to be the largest retrievable data base of its type in the country. These abstracts are on computer simulation models, application and computational programs, and information-retrieval systems covering "all fields of knowledge from business, government, industry, military, and universities."

The computer-program information is disseminated in two forms: as a quarterly program-index newsletter at $10 a year, and as special abstract reports on each subject area at $19 for up to the first 200 abstracts and $6 for up to each additional 200 abstracts.

For a free report index, write to NCPAS, P.O. Box 3873, Washington, DC 20007.

DESIGNING WITH MICROPROCESSORS

This tutorial deals with the principles and practises of microcomputer design, covering such topics as chip architecture, microprocessor selection criteria, software aids, development systems, microprocessor applications, networks, busing strategies, and distributed intelligence. To IEEE members, $7.50; nonmembers, $10.

IEEE Computer Society, 5855 Naples Plaza, Suite 301, Long Beach, CA 90803.

ACM ADMINISTRATIVE DIRECTORY

The 1977 edition of the ACM Administrative Directory of Chairman of University and College Computer Science Departments and Directors of Computer Centers provides names, addresses, and telephone numbers, and lists computer-science and data-processing degrees offered and major on-site computing equipment. The officers and key staff members of related computer organizations are included. The directory consists of more than 2300 names, and is $7 for ACM members, $9 for others.

ACM Order Department, P.O. Box 12105, Church Street Station, New York, NY 10249.

COMPUTER-ORIENTED BOOK BIBLIOGRAPHY

More than 225 new books are listed in the tenth edition of the *Annual Bibliography of Computer-Oriented Books,* published by the University of Colorado. Even with all books before 1971 deleted, the bibliography still contains more than 1,000 books from 210 publishers.

Books are separated into 55 categories and catalog according to type and style of presentation. A new category was added this year: program design. The bibliography is $4; or $5 if an invoice is required.

Computing Newsletter, Box 7345, Colorado Springs, CO 80933.

MAGAZINES, JOURNALS

SMALL BUSINESS COMPUTOR

Announced by a computer consulting firm, *Small Business Computor* is a series of management reports aimed at educating and assisting the "small business executive in the use of computers, computing, and data processing to better manage and control the small business."

SEI Publications, P.O. Box 145, Newington, CT 06111. (203) 667-2096.

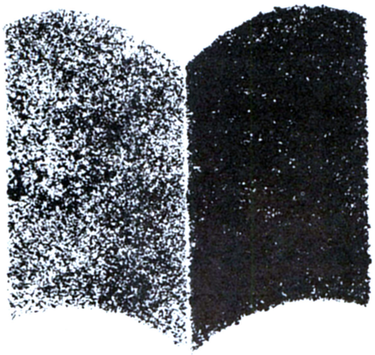
PERSONAL COMPUTER NEWS

This newsletter is aimed at the user, supplier and the "insider who would like to be able to pinpoint certain articles and products covered by the many available periodicals." Each monthly issue will review, abstract and index *Creative Computing Computer, Byte,* plus "eleven other authoriative magazines."

In addition, independent evaluations are conducted on popular products, systems, and software. Space is provided for a subscriber Trading Post. Annual subscription is $9; a sample issue is $1.

Personal Computer News, Numicraft, Inc., P.O. Box 425, Dayton, OH 45419.

VENDOR LITERATURE



APL BOOK CATALOG

The book list from APL Press describes six publications involving APL: three introductory booklets; and three books, on algebra, elementary analysis, and calculus.

APL Press, Box 27, Swarthmore, PA 19081. (215) 328-9771.

HP CACULATORS

Hewlett-Packard's *Personal Calculator Digest* for 1977 is 32-page magazine and product catalog covering their top eight calculators, both hand-held and printing types.

Hewlett-Packard, Corvallis Division, 1000 N.E. Circle Blvd., Corvallis, OR 97330.

CATALOG OF BREADBOARDING AND TEST EQUIPMENT

Continental Specialties' latest hobbyist catalog offers breadboard and test equipment for the hobbyist and the professional. Included are breadboard sockets, pre-assembled breadboards, logic monitors and probes, function and pulse generators, R/C bridge, test clips, and components.

Continental Specialties Corp., 44 Kendall St., P.O. Box 1942, New Haven, CT 06509. (203) 624-3103.

PROCESSOR TECH CATALOG

A 22-page color catalog describes the complete line of Processory Technology computers, computer systems, peripheral equipment and software. Applications as well as equipment are discussed, including systems, personality modules, memories, disk storage, and interfaces.

Processor Technology Corp., 6200 Hollis St., Emeryville, CA 94608. (415) 652-8080.

COMPUTERS

OSI CHALLENGER SYSTEM

The OSI Challenger integrated computer system for business and professional users consists of a Challenger 65 mainframe, 16K of RAM, system monitor and disk bootstrap PROMs, and serial interface. It also includes a Challenger single-drive floppy disk based on the GSI 110 drive, plus a stand-alone CRT terminal and Sanyo monitor.

The system comes with disk operating system, disk-based 6502 resident assembler/editor that also contains a line editor, extended monitor (machine-language debugging and utilities package including a disassembler), 8K disk BASIC, and BASIC program library. Complete system, $2599; without CRT terminal and monitor, $2,099.

Ohio Scientific Instruments, 11679 Hayden St., Hiram, OH 44234. (216) 569-7945.

APPLE-II COMPUTER

Apple-II, from Apple Computer, incorporates color graphics along with color-graphics commands in BASIC, a ROM BASIC and monitor, and 16K RAM chips to achieve 48K bytes of on-board memory. The single-board Apple-II uses a 6502 MPU, up to 12K bytes of ROM (8k supplied: 6K BASIC, 2 K monitor), cassette interface, ASCII keyboard, and the Apple game connector for paddles and other game

BITS, BYTES & BALONEY!

For all of you non-aficionados of the Computer Art. . . .

BIT — an electrical signal or logic level (like the zero or one of the Binary numbering system) — Motorola's M6800 is an 8-bit MPU.

BYTE — a set of eight electrical signals, or logic levels (bits) — The M6800 is capable of addressing 65,000 bytes of memory.

BALONEY — the state-of-the-MPU-art that says that you must be a trained computer expert to use a Microprocessor in a practical manner. More and more "individuals" are becoming self-styled computer 'experts' at home, with their own MPU kits. They are doing things that others said, "couldn't be done," (just because they forgot to ask).

NOW'S YOUR CHANCE — for only **$235.00** (plus $5.00 postage and handling) you can order your MOTOROLA M6800 MICROPROCESSOR EVALUATION DESIGN KIT, directly from Motorola.

IT'S A COMPLETE KIT — the MEK6800D2 Kit has all the parts necessary to complete the system and get "On The Air," except for the Power Supply. It includes:

- (1) MC6800 Microprocessing Unit
- (2) MCM6810 — 128 x 8 Static RAMs
- (2) MC6820L — PIA's
- (1) MC6830L — Program ROM
- (1) MC6850L — ACIA
- (2) Printed Circuit Boards
- (1) MC6871 — Clock
- (1) 6-Digit Seven Segment Display
- (1) 24-key Keyboard
- Complete kit of resistors, capacitors, sockets, circuits, etc. All the parts necessary to the system, but the Power Supply.

THE M6800 MPU KIT FEATURES

- 24-key Keyboard
- 7 Segment Display
- Cassette Interface
- EROM Expandable
- RAM Expandable
- Wire Wrap Capability
- Parallel & Serial
- Interface Capability
- Single 5-Volt Supply Required
- Layout on Boards
- Documentation

IF YOU'RE READY FOR A MICROPROCESSOR — THE M6800 IS READY FOR YOU!

Send your order in today for one of the most powerful MPU Kits on the market. Fill in the order form below and mail it with your check to:

MOTOROLA
MPU KIT SALES
Department CC
P.O. Box 27605
Tempe, AZ. 85282

M6800
EVALUATION KIT II

I have enclosed $235.00 plus $5.00 (shipping & handling) in check or money order for each MEK6800D2 Microprocessor Design Kit II. Please send__________Kit(s).

NAME ____________________

ADDRESS ____________________

CITY ____________________

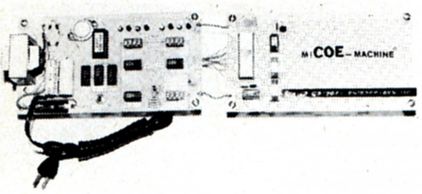
STATE ____________ZIP ______

Please print clearly — Make checks payable to Motorola Inc.

MOTOROLA
Semiconductor Products Inc.

controls. The video display controls 40-character 24-line text, and 16-color graphics. Apple-II is $598 assembled and tested; the keyboard is $1298. There's a 20 percent discount on additional memory if bought with the computer.

Apple Computer Co. Inc., 20863 Stevens Creek Blvd. B3-C, Cupertino, CA 95014. (408) 996-1010.



MICROPUTER KIT

From Child Odyssey Enterprises, the miCOE kit is assembled on two pieces of Micro Vectorboard by hardwiring. One board contains the power supply, I/O and control section, 8 DIP toggle switches, 8 LEDs, and 4 DIP control switches. The other board contains the RCA COSMAC 1802 MPU, 256 bytes of memory, clock circuit, and room for expansion. All ICs are provided with sockets. Wire Wrap is available for $10. Accessories will be available including cabinet, memory, I/O kits, etc. $90.

Child Odyssey Enterprises, Inc., P.O. Box 137, Alamogordo, NM 88310.

TDL'S XITAN

The two Xitan systems from Technical Design Labs are based on the Z-80 MPU. Xitan *alpha 1* has a ZPU board (CPU card) and a system monitor board in a small case with power supply, eight slots on the mother board, front-panel reset switch, rear-mounted power switch, and a DIP switch that replaces front-panel "sense switches." The *alpha 2* adds to this the Z16 memory bord with 16K in 4K increments, and a software package consisting of Zapple 8K BASIC, Zapple text editor, text output processor, and relocating macro assembler. The *alpha 2* has 18K of RAM, 2K of ROM, two serial I/O ports, one parallel I/O port, 1200-baud audio-cassette interface. The Xitan *alpha 1* is $769 kit, $1039 assembled; *alpha 2* is $1369 kit, $1749 assembled.

Technical Design Labs, Research Park, Bldg. H, 1101 State Rd., Princeton, NJ 08540.

LOST-COST COMPUTER SYSTEM FOR DOCTORS

A new low-cost system from NCR for the accounting needs of the one- or two-physician practice is a turnkey system using the operator-oriented 299 accounting computer. The two basic applications are patient billing, which automatically prepares a statement with five credit descriptions and up to 70 service descriptions, as well as self-addressed return envelopes; and accounts-receivable, which posts all payments, balances any refund that has to be made, and provides an aging analysis of the receivables. The system includes a magnetic-ledger handler, and is priced at $12,500.

NCR Corp., Dayton, OH 45479. (513) 449-2150.

ORGANIZATIONS

PASCAL USERS GROUP

Membership in the Pascal User's Group is open to anyone interested in using, implementing, maintaining or just learning about Pascal, an Algol-like language designed for structured programming. Dues are $4 per academic year. All members receive quarterly issues of the *Pascal Newsletter,* covering Pascal, structured programming, language design, letters from members, implementation news, editorials, and book reviews. The last three issues of the newsletter totalled 395 pages per $1 of dues, quite a bargain.

Pasacal User's Group, c/o Andy Mickel, University Computer Center: 227 Exp Eng,

TERMINALS

CONTROL DATA EDUCATION TERMINAL

The new terminal introduced by Control Data for use with their PLATO computer-based education system, is priced 23 percent lower than the previous model. A major feature of the terminal is its ability to respond when the user merely touches the screen. Options permit attaching multi-media equipment such as printers, mark-sense readers, audio-visual devices and on-line data-capturing devices. $6,800.

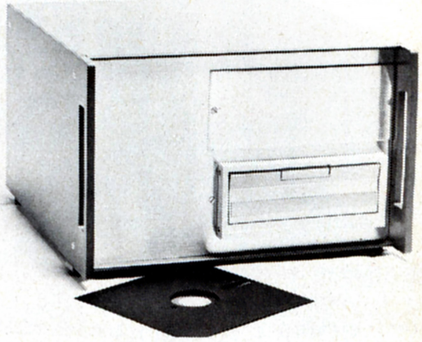
Control Data Corp., P.O. Box O, Minneapolis, MN 55440.

CT-64 TERMINAL SYSTEM

The Southwest Technical Products Corporation CT-64 Terminal System kit, along with the optional CT-VM monitor, is a complete package providing a complete stand-alone terminal system compatible with modems and ASCII computer systems. The kit features 16 lines of 32 or 64 characters per line, scrolling or page mode operation, upper and lower-case characters, reversed character printing, control character printing, cursor control and complete control-character decoding. The kit includes the power supply, keyboard, serial interface, beeper, assembly instructions, chassis and cover and is sold in kit form only, $325. The optional CT-VM video monitor is sold assembled, requires the CT-64's power supply and is $175.

Southwest Technical Products Corp., 219 W. Rhapsody, San Antonio, TX 78216. (512) 344-0241.

PERIPHERALS



EPA MICROPROCESSOR FLOPPY-DISK SYSTEM

The EPA Micro-68 floppy-disk system for the 6800 microprocessor is housed in a ruggedized aluminum cabinet, and comes complete single or dual disk drive, drive electronics, controller and exorcisor-compatible interface for the 6800. Each IBM-compatible disk holds a quarter of a million words of information. Price, complete with power supplies, is $2595 for the single-drive system and $3295 for the dual-drive system. Floppy-disk operating system, assembler and editor are included.

Electronic Product Associates, Inc., 1157 Vega St., San Diego, CA 92110. (714) 276-8911.

Sol Terminal Computer
Processor Technology

The Small Computer

Twenty-five years ago a computer as powerful as the new Processor Technology Sol-20 priced out at a cool million.

Now for only $995 in kit form or $1495 fully assembled and tested you can have your own small computer with perhaps even more power. It comes in a package about the size of a typewriter. And there's nothing like it on the market today. Not from IBM, Burroughs, DEC, HP or anybody else!

It fills a new role

If you're an engineer, scientist or businessman, the Sol-20 can help you solve many or all of your design problems, help you quantify research, and handle the books too. For not much more than the price of a good calculator, you can have high level computer power.

Use it in the office, lab, plant or home

Sol-20 is a smart terminal for distributed processing. Sol-20 is a stand alone computer for data collection, handling and analysis. Sol-20 is a text editor. In fact, Sol-20 is the key element of a full fledged computer system including hardware, software and peripheral gear. It's a computer system with a keyboard, extra memory, I/O interfaces, factory backup, service notes, users group.

It's a computer you can take home after hours to play or create sophisticated games, do your personal books and taxes, and a whole host of other tasks.

Those of you who are familiar with small computers will recognize what an advance the Sol-20 is.

Sol-20 offers all these features as standard:

8080 microprocessor — 1024 character video display circuitry — control PROM memory — 1024 words of static low-power RAM — 1024 words of preprogrammed PROM — built-in cassette interface capable of controlling two recorders at 1200 bits per second — both parallel and serial standardized interface connectors — a complete power supply including ultra quiet fan — a beautiful case with solid walnut sides — software which includes a preprogrammed PROM personality module and a data cassette with BASIC-5 language plus two sophisticated computer video games — the ability to work with all S-100 bus products.

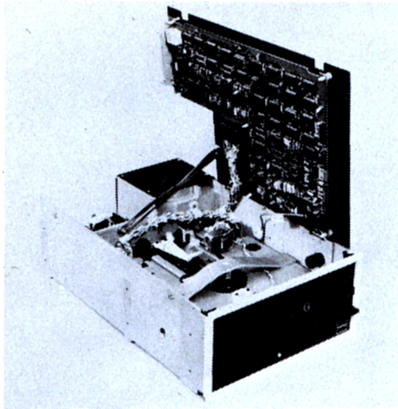
Full expansion capability

Tailor the Sol-20 system to your applications with our complete line of peripheral products. These include the video monitor, audio cassette and digital tape systems, dual floppy disc system, expansion memories, and interfaces.

Write for our new 22 page catalog. Get all the details.

Processor Technology, Box C, 6200 Hollis St., Emeryville, CA 94608. (415) 652-8080.

Processor Technology Corporation



FLOPPY DISK

The Series 400 diskette drive by Innovex features automatic head-unload and stepper-motor time-outs, bi-directional write-protect, radial stepping ability for overlapping seeks, host power-failure detector, and six different LED activity indicators. Both the 410 (hard-sectored) drives provide single and double-density recording. A proprietary data-separator design, coupled with a digital noise filter and a unique way of handling recorded signals, is said to give 35 percent greater integrity margins than competing drives. Prices start at $575 each.

Innovex Corp., 75 Wiggins Ave., Bedford, MA 01730. (617) 275-2110.

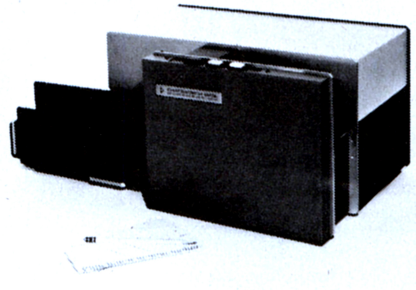
FLOPPY DISK MEMORY FOR 6800 AND OTHERS

The MSI FD-8 floppy-disk memory system will interface to any microcomputer systems via a single PIA chip. The FD-8 uses GSI disk drives, with each drive in its own cabinet, complete with power supply. The disk controller board is in the same cabinet at the #1 drive, and communicates with the microcomputer system via a small ribbon cable. Up to four disk drives connect to the #1 system by a parallel cable.

The FD-8 controller board contains a sector buffer. About 3K of RAM is on the controller board itself, allowing information to be transferred from controller to disk completely independently from processor speed. Software includes all the driver subroutines and MINI-DOS routines. Single-drive kit $1,150; assembled $1,395. Dual-drive kit $1,950; assembled $2,295.

The MSI FDOS operating system, for use with the FD-8 and 6800-based systems, provides operations such as CATALOG or FILES, CREATE, SAVE, PURGE, INITIALIZE, COPY, RENAME, LOAD, RUN, PACK, LIST, CORES, and BASIC. The FDOS package is provided at no additional charge to users of the FD-8 disk memory system. Additional copies are $45.

Midwest Scientific Instruments, Inc., 220 West Cedar, Olathe, KS 66061. (913) 764-3273.

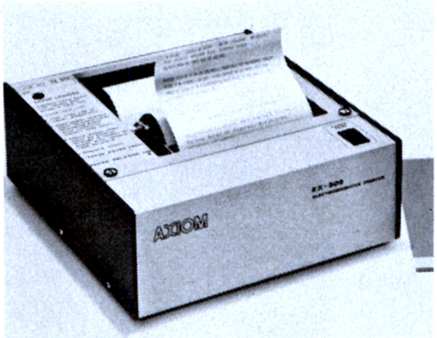


READER FOR PUNCHED OR MARKED CARDS

Chatsworth Data Corp. has expanded its 4000 series of optical readers with the 4300 EDT model, designed primarily for the education market for use in test scoring, grade reporting, attendance, etc. The unit reads both standard punched tab cards and cards marked with a soft lead pencil. Card length can vary from 4⅞ to 14 inches.

The reader converts the card data to ASCII or binary (card image) and transmits the information over a standard RS232-C interface at five switch-selectable baud rates, at half or full duplex. The output data can be simultaneously transmitted to a local printer and modem for transmission to a remote printer. Card feed can be continuous or externally controlled (feeds when X-ON character is read). $2,995.

Frank Lefkowitz, Chatsworth Data Corp., 20710 Lassen St., Chatsworth, CA 91311. (213) 341-9200.



80-COLUMN LINE PRINTER

A compact 80-column line printer operating at 160 characters per second (14 times faster than a Teletype) is offered by the Axiom Corp. The Axiom EX-800 is a stand-alone printer with case, power supply, ASCII interface, character generator, and paper-rol holder, ready to plug in. An RS232C serial interface is $85.

The EX-800, which prints by dot matrix on five-inch-wide electrosensitive paper, has an infra-red low-paper detector, bell, programmable character size, built-in self tester, and multi-line asynchronous input buffer. $655.

Axiom Corp., 5932 San Fernando Road, Glendale, CA 91202. (213) 245-9244.

SPEECH SYNTHESIZER

The Computalker CT-1 Speech Synthesizer is a voice-generator unit, controlled by nine acoustic-phonetic parameters transmitted on the microcomputer Altair S-100 data bus. In Direct Control mode, the CT-1 is operated directly from parameters stored in memory, and can provide high-quality speech output. Another mode uses a system of phonetic rules to generate the synthesis control parameters from input phonetic text. Assembled and tested, $395.

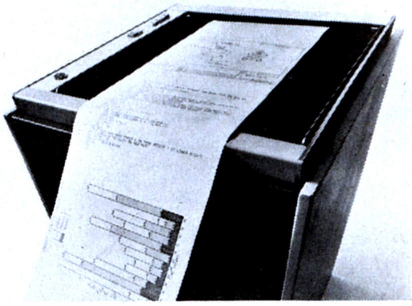
Computalker Consultants, P.O. Box 1951, Santa Monica, CA 90406. (213) 392-5230.

TAPE WINDER

Elliam Associates says that the battery-operated Handy Dandy Tape Winder described in our Jan/Feb issue hasn't been available for over a year.

But they do have a 110-volt model at $27 (plus $1.25 handling), and a hand-held model at $3.30.

Elliam Associates, 24365 Clipstone St., Woodland Hills, CA 91367. (213) 348-4278.



VARIAN DUAL-DENSITY PRINTER/PLOTTER

Varian Associates Graphics Division has a new Dual Density Statos 42 Series printer/plotter that offers switch-selectable alternatives of 100- or 200-dot-per-inch resolution. The 100-dot density is often desirable for "quick-look" plots of specific data, while the 200-dot density is of high enough quality to serve as photoready copy in reports. The Dual Density option for the Statos 42 Series printer/plotter starts at $1,500.

Varian Graphics Div., 611 Hansen Way, Palo Alto, CA 94303. (415) 493-4000.

PROCESSOR TECHNOLOGY FAST-START SUBSYSTEM

A subsystem package designed to get microcomputers up and on the air faster, the Subsystem B from Processor Technology, is offered in three different modules differing only by amount of memory. Made for computers such as the Altair, Imsai and Cromemco Z-2, Subsystem B includes RAM and PROM memory, parallel, serial, cassette and video-display interfaces and software, plus a bootstrap loader program to load CUTS 1200-baud cassette tapes.

Each package includes a VDM-1 display I/O, 3P+S parallel/serial I/O, and the 4KRA, 8KRA or 16KRA memory, depending on the model. The B70, with 7K bytes total memory, is $594; B110, with 11K, $730; B190, with 19K, $964.

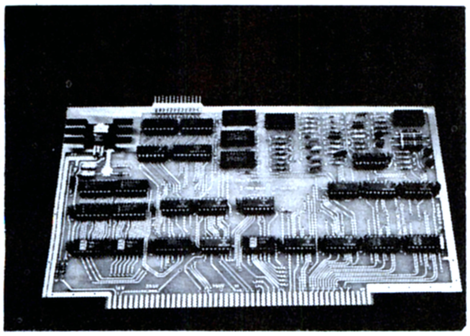
Processor Technology Corp., 6200 Hollis St., Emeryville, CA 94608. (415) 652-8080.

VIDEO DISPLAY BOARD

The VDB display board from Technical Design Labs is compatible with the S-100 bus, and features 80 characters per line; 25 lines per screen; 64 graphic characters; independent memory (not part of processor's address space); two full screens of display memory, upper/lower case with descenders; on-board 8-bit parallel port for keyboard and status lights; software drivers that require no RAM (can be put in ROM); software-controlled character inversion, character blink, display inversion, cursor, display inhibition; software-addressable cursor; and software-readable cursor and display memory. Prices haven't been set yet, as the VDB is very new.

Technical Design Labs, Research Park, Bldg. H, 1101 State Rd., Princeton, NJ 08540.

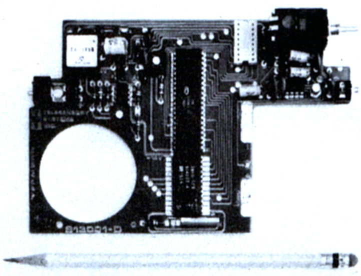
MISC. HARDWARE

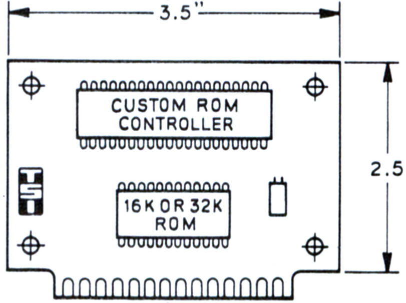


I/O BOARD

Compatible with the Altair S-100 and Kansas City standard data format, the Morrow I/O board links a microcomputer to three inexpensive audio-cassette machines for mass-memory appplications, including sort and merge operations. Serial and parallel ports are provided. The board carries 500 bytes of PROM containing the routines needed for cassette interfacing, UART simulation and data trnasfer. Kit $120; assembled and tested, $165.

Morrow's Micro-stuff, Box 6194, Albany CA 94706. (415) 527-7584.





Introducing—
New Low-Cost Fixed Vocabulary

Speech Synthesizers**

OUR SPEECH+™ CALCULATOR SPEECH BOARD

- 24-word vocabulary suitable for numeric readouts, calculators
- Single 5V power supply—battery operated
- Clear, highly intelligible male voice
- MOS-LSI circuitry
- 16-pin DIP socket interface

Availability:
In stock (English or German)
Price:
$150.00 each*

NEW! EXPANDED VOCABULARY MINI-BOARDS

- Two expanded vocabularies will be available soon:
  (1) Full *spoken* numerics (to 999,999) plus a variety of measurement words (total 56 words)
  (2) The ASCII character set—numerics, alphabet, special symbols (total 64 words).
- Small size—3½"x 2½"
- Edge Connector, mounting holes

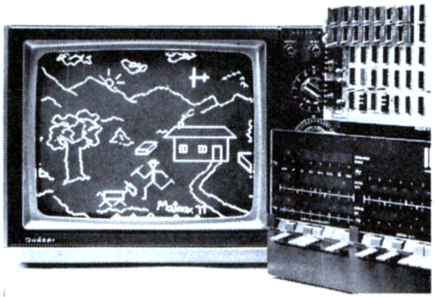
Availability:
Third Quarter, 1977
Price:
$179.00 each *

*Plus state sales taxes where applicable.
**Invented by Dr. Forrest Mozer

For detailed vocabulary lists and specifications, write or call:

TSI

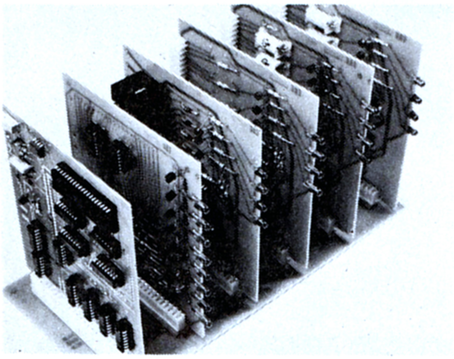
TELESENSORY SYSTEMS, INC.
3408 Hillview Avenue, Box S-01
Palo Alto, California 94304
Telephone: (415) 493-2626
Attention: Paul Obester



GRAPHICS SYSTEM

The Matrox ALT-256**2 is a 256-by-256 high-resolution graphics device that plugs into the Altair S-100 bus. The card contains all interface electronics, a TV sync generator and its own 65K X 1-bit refresh memory. Four output ports are required, two for storing the X and Y coordinates of the addressed dot, another to turn the dot on or off, and a fourth port to clear or preset the entire screen. Multiple ALT 256**2 cards may be combined to form graphic systems with grey scale or color capability. The card can also be syncronized to an external sync generator chip for use in systems where video mixing is required. $395 assembled.

Matrox Electronic Systems, P.O. Box 56, Ahuntsic Station, Montreal, Quebec, Canada H3L 3N5. (514) 481-6838.



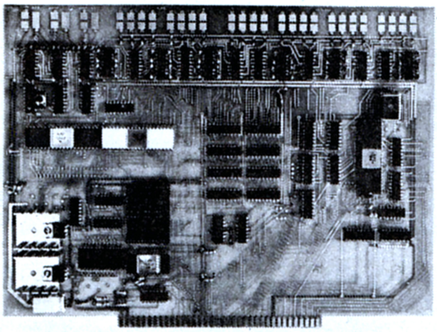
CONTROL INTERFACES

From CRC Engineering, an interface system called XPRESS allows control of up to 128 separate devices or circuits through one 8-bit port or one ASCII serial interface. Devices controlled may include a home or business energy-management system, stereo system, room lights, sprinkler systems, burglar alarms, or experiments in a university environment.

XPRESS consists of a mother board and interface boards that include reed relays, AC opto, AC relays, and remote drivers. LEDs display the status of each interface board and of the 8-bit XPRESS bus.

An MPRES card allows the user's processor to poll the status of 8 individual, external, optically isolated points, and multiple MPRES cards allow polling of up to 256 individual points. Prices of the mother board and interfaces range from $17 to $58.

CRC Engineering, Inc., P.O. Box 6263, Bellevue, WA 98007. (207) 855-7038.

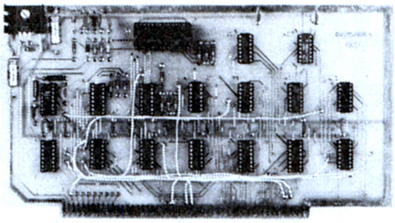


DATAC COMPUTER CARD

The Datac 1000 computer and controller card is available in two configurations. The minimum uses a 6502 MPU, one page of RAM (256 bytes), touch-pad switches (8 data, 8 address, 9 control), 8 data and 8 address LEDs, and single-cycle operation. The tourch pads are said to allow bit-by-bit data entry much faster than conventional toggle or slide switches.

In fully populated form, the Datac 1000 offers full 16-bit addressing, 1K bytes of RAM, sockets for 2K of ROM, Teletype I/O monitor in ROM plus 64 bytes of RAM plus 8-bit I/O port, Teletype or RS232 interface, high-speed cassette interface, two parallel ports, and power-on reset or restart. Assembled and tested, with power supply, the minimum board is $185; the fully populated board (less EROM) is $345.

Datac Engineering, P.O. Box 406. Southampton, PA 18966. (609) 854-7852.

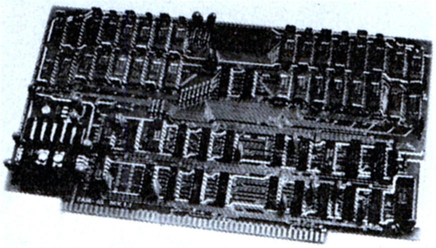


MICROCOMPUTER CLOCK

Comptek's CL2400 is an Altair S-100 bus real-time clock that keeps the time of day in hours, minutes and seconds. The self-contained hardware clock continually updates the time, using the 60-Hz AC power-line frequency as a reference. Because it is treated as a peripheral by the CPU, the CL2400 eliminates the memory and execution time inherent with interrupt-driven clocks. A hold mode and two fast modes permit setting the present time into the clock.

The CL2400 can also generate periodic interrupts to the CPU at any of six programmable rates, from twice each day through once each second. This feature assists in scheduling tasks to be performed at specific times, and for continuously updating the time on a CRT display. With simple programs in both 8080 assembly language and BASIC, the CL2400 clock is $98 kit, $135 assembled.

Comptek, P.O. Box 516, La Canada, CA 91011.



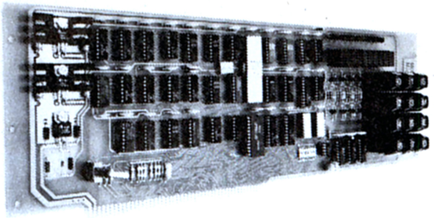
IMSAI MEGABYTE MEMORY

Imsai offers a megabyte memory system for microcomputers, based on 65K, 32K and 16K RAM boards controlled by an Intelligent Memory Manager (IMM), for the Imsai 8080 an other Altair S-100 computers. In multiprocessor systems, the Imsai Shared Memory Facility permits shared memory blocks of up to 65K bytes, and each processor can address up to one megabyte total of shared and local memory.

The IMM board provides for memory expansion to one megabyte, write protect for each 1K block, read protection, fully vectored interrupts, time-of-day clock and real-time clock. Memory expansion involves increasing the number of address lines from 16 to 20, and using block switching to control the four added lines.

The 65K RAM board is $2599 kit, $3899 assembled; 32K RAM board, $739 kit, $1099 assembled; IMM ROM control, $299 kit, $399 assembled; IMM EROM control, $499 kit, $699 assembled.

Imasai Manufacturing Corp., 14860 Wicks Blvd., San Leandro, CA 94577. (415) 483-2093.



CPU BOARD/FRONT PANEL

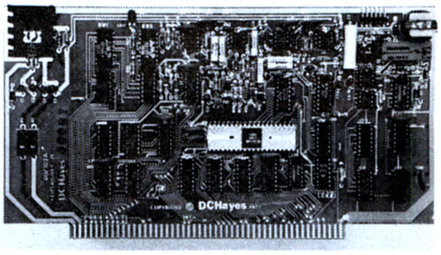
CPU board and front panel of existing microcomputer systems "to achieve mini-computer performance," or form the basis of a custom system, using peripherals and a mother board. A Slow Step mode steps through the program at a rate variable from 1 to 65,000 steps per minute. The Control Halt mode prevents the 8080A MPU from shutting off after a HALT instruction. A 12-key octal keyboard and ten 7-segment readouts are provided. Kit form $250; assembled and tested, $325.

Morrow's Micro-Stuff, Box 6194, Albany, CA 94706. (415) 527-7548.

IBM-TO-MICRO LINK

A family of synchronous data-communications interfaces for microcomputer systems, which permit connection to standard IBM telecommunications hardware and software, has been introduced by Adtech. The interfaces provide a simple connection between the S-100 bus and mainframes that use IBM's Binary Synchronous Communications (BSC) protocol. Each interface requires two S-100 card slots, and communicates through an RS232C connector. Each interface transfers data through direct memory access. $1,595.

Adtech, Inc., P.O. Box 10415, Honolulu, HI 96816.

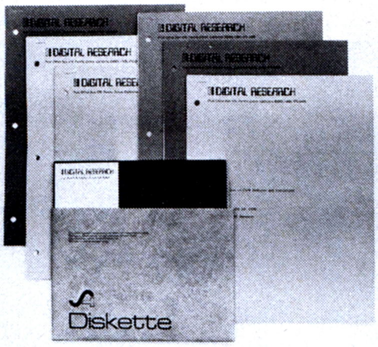


DATA COMMUNICATIONS MODULE

The 80-103A data communications adapter from D.C. Hayes is an Altair S-100 compatible asynchronous serial module with a fully-programmable frequency-shift-keyed (FSK) modem. Programmable features include auto dial and answer, originate answer mode, data rate of 100 to 300 bps, echo-suppress tone generator, error detection, and self-test board with manual $49.95, manual only $7.50.

D.C. Hayes, P.O. Box 9884, Atlanta GA 30319.

SOFTWARE



DISK OPERATING SYSTEM

CP/M is Digital Research's low-cost disk operating system designed for IBM-compatible diskette-based computer systems that use the 8080 MPU. The functions of this software package include named dynamic files, program editing, assembly, debugging, batch processing, and instantaneous program loaging. CP/M is an "unbundled" software package that can be adapted to any 8080 or Z-80 system with at least 16K of main memory and one or two IBM-compatible disk drives. The standard CP/M system operates on an Intel MDS, but the manual shows how to alter CP/M for other hardware configurations. CP/M in object form is $70; documentation (set of six manuals) alone is $25.

Digital Research, P.O. Box 579, Pacific Grove, CA 93950. (408) 373-3403.

TYCHON EDITOR/ ASSEMBLER

Tychon's co-resident editor/assembler (TEA) for 8080 systems requires only 5K of memory (read/write or PROM), and is completely I/O independent, relying upon its own I/O software or the I/O routines already available in the user's system. TEA accepts both octal and hex values; the switch from one to the other is made at any time using keyboard commands. The editor/assembler is a relocatable. The program is available in 1702A or 2708 PROMs and on paper tape; listings are also available. Prices start at $35 for a paper-type version plus the user's manual.

Tychon, Inc., P.O. Box 242, Blacksburg, VA 240600. (703) 951-9030.

MEDICAL DATA SERVICES

NCR and B-D Spear Medical Systems have combined the data-processing services that both companies offer to the health-care industry. A new interface allows NCR computerized medical system to act in concert with B-D Spear's systems. NCR systems handle a variety of data-entry, accounting and patient record-keeping functions, while B-D Spear's systems specialize in monitoring and collecting data related to th use of laboratory equipment. Thus a hospital with a NCR patient-accouting system can install a B-D Spears laboratory system and automatically receive on-line billing data on all laboratory procedures.

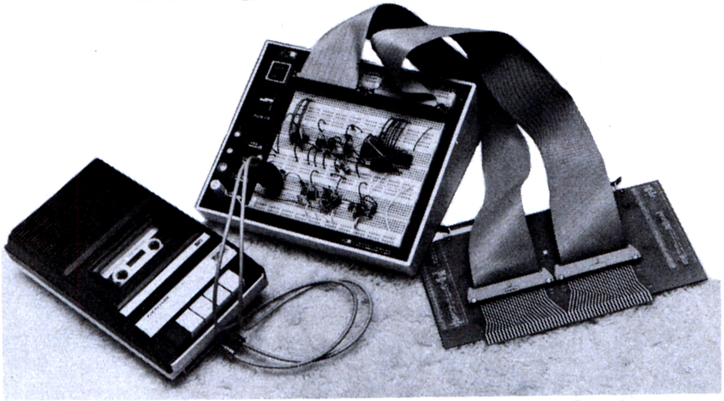
The Spear system will also function directly with NCR MEDICS (Medical Information and Communications System, an on-line system that links various hospital departments, using a network of terminals connected with a central computer.

NCR Corp., Dayton, OH 45479. (513) 449-2150.

TEXT EDITING SYSTEM

The new TSC Editing System is said to be the most extensive text editor available to the micro user. It supports many of the standard commands such as PRINT, INSERT, DELETE, FIND, REPLACE AND VERIFY. Pointer movers are provided for file TOP and BOTTOM, and text block COPY and MOVE are performed with a single command. Other features include tab character definition, TAB column set, special character SET command, line NUMBERS on or off, STOP and LOG command, and an OVERLAY command for changing a line by typing over it. Price, including source listing, hex dump, sample output and users manual, is $23.50.

Technical Systems Consultants, Box 2574, W. Lafayette, IN 47906.



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8080 SOFTWARE

Freeman Associates has released a Dynamic Debugging Tool, to help debug 8080-based microcomputers at the assembly-language level. Binary tapes of DDT are available in the MITS checksum format for loading by the Package II Monitor and are fully compatible with the MITS assembly table, allowing full use of the DDT symbolic addressing capability.

DDT features symbolic referencing and addressing, over 50 commands including Single Step, Dump Forward, Iterate Single, and Software Protect, plus a string mode used to look at long messages, and an optional floating-point model. Binary tape, $150; documentation package, $5 (hobbyist prices).

Freeman Associates, P.O. Box 859, Hopkinsville, KY 42240.

MULTIPROGRAMMING OPERATING SYSTEMS

Data General has new software for its Eclipse family of computers, a "heuristic" or intelligent multiprogramming Advanced Operating System (AOS). Eclipse systems with multiprogramming AOS can control multiple, concurrent timesharing, batch, and real-time operations. AOS manages these operations heuristically, constantly monitoring all activities and automatically adapting the system to both user priorities and past behavior of the various operations. This internal intelligence is said to make highly efficient use of system resources — memory space, CPU time, mass-memory storage and peripheral I/O devices — and provides fast interactive response while maintaining high-volume batch throughput.

High-level languages available with AOS include Extended BASIC, real-time Fortran IV, optimizing Fortran V and a macro assembler.

Barbara Nolan, Data General Corp., Southboro, MA 01772. (617) 485-9100, X-2737.

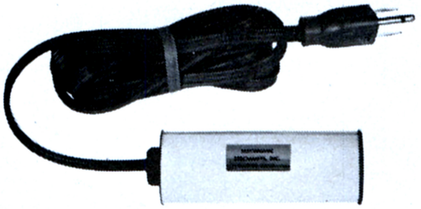
8080 FORTRAN IV COMPILER

Microsoft's FORTRAN IV compiler for the 8080 microprocessor is a full implementation of ANSI Standard Fortran except for the double-precision and complex-data types. FORTRAN-80 provides three data types: logical (one-byte), integer (two-byte) and real (four-byte floating point). The compiler generates pure, relocatable code that may be placed in ROM, and the runtime package may also be placed in ROM.

The one-pass compiler required less than 12K bytes of memory, and the runtime system less than 6K bytes. Included are a relocating linking loader, relocating assembler, and assembly-language debugging program. FORTRAN-80 is $500 including documentation; the manual alone, $15.

Microsoft, 819 Two Park Central Tower, Albuquerque, NM 87108. (505) 256-3600.

MISCELLANEOUS



POWER-LINE FILTER

From Electronic Specialists, a power-line interference filter is designed for use where microprocessor Teletype, TV games or other interference enters the power line. Two-conductor model, $10.50; three-conductor, $13.50.

Electronic Specialists, Box 122, Natick, MA 01760. (617) 655-1532.

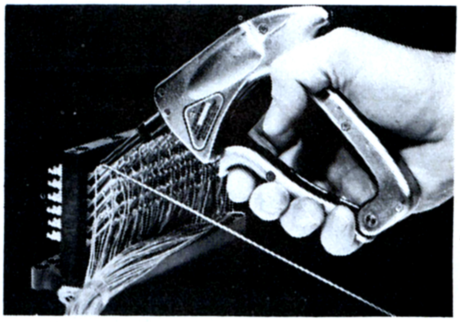
COMPUTER WEAR DAILY

Now the computerist's dilemma "what shall I wear today?" has been imaginatively solved with Martha Herman's computer tee shirt designs. Ten different phrases in MICR on bright colored tee shirts make it possible to wear a different shirt/message each day of the week. The complete collection is:

DOES NOT COMPUTE on a light blue shirt
RANDOM ACCESS on orange
SYSTEM UP AND RUNNING on yellow
DEBUGGING DEVICE on royal blue
SIMULATED LOGIC on gold
GARBAGE IN—GARBAGE OUT on red orange
BASIC PROGRAMMER on aqua
SOFTWARE on mint green
ARTIFICIAL INTELLIGENCE on dark green
COMPUTER WIDOW on rose

Martha is always interested in new ideas for the computer shirts, and she'll send a free shirt to the originator of any new phrase she prints. The message should be a computer related comment about the wearer. Her shirts are available at computer retailers or by mail ($5.00 plus .60 postage per shirt) at the above address.

Send your ideas to Martha Herman, 114 West 17th St. New York, N.Y. 10011.

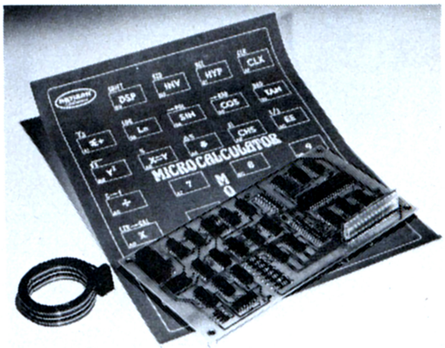


SPEED-WRAP TOOL

The G200/R3278 Speed Wrap tool from OK is designed to produce solderless wire-wrapped connections with a squeeze of the trigger. Hardened steel working parts are said to ensure long life and touble-free service. For 22-30 AWG wire. $29.85.

OK Machine and Tool Corp., 3455 Conner St., Bronx, NY 10475. (212) 994-6600.

CALCULATORS



MICROCALCULATOR

Artisan Electronics has developed a microcalculator, model 85, for operation with 8-bit microprocessors. The 85 required only 5 volts, and interfaces, through an 8-bit bi-directional I/I port, the Motorola 6820 and others. Each entry that would normally be made by a key is replaced by an 8-bit instruction from the microprocessor. Output is a 14-digit display back to the microprocessor for storage or display. The 85 has scientific calculation capabilities, and contains a four-register stack with nine memory registers. Problem-solving capability includes logarithms, sines and tangents, polar/rectangular coordinate conversions, constants for pi and e, and four metric/U.S. unit constants for conversions. The Microcalculator Model 85 is $189 assembled.

Artisan Electronics Corp., 5 Eastmans Rd., Parsippany, NJ 07054. (201) 887-7100.

Building a better computer wasn't easy. But we did it.

Introducing the MSI 6800 Computer System

When we set out to build the new MSI 6800 Computer System, we knew we had our work cut out for us. It had to be at least as good as the now famous MSI FD-8 Floppy Disk Memory System which is also pictured below. So, the first thing we did was analyze all the problems and drawbacks we had encountered with other 6800 systems, and then put our engineers to work on solutions. The objective: Build a better computer.

FD-8 DISK MEMORY
Midwest Scientific Instruments Olathe Kansas
MSI 6800 COMPUTER SYSTEM
Midwest Scientific Instruments
Olathe Kansas
Power

We started with power supply. We had big ideas, so we used a hefty 18 amp power supply. You can run full memory and several peripherals without the worry of running out of juice. We also put it in the front of the cabinet so it's out of the way.

The next step was the CPU Board. A separate baud rate generator with strappable clock outputs allows any combination of baud rates up to 9600. A separate strappable system clock is available and allows CPU speeds of up to 2 MHz. The new MSI monitor is MIKBUG software compatible, so you will never have a problem with programs. Additional PROM sockets are available for your own special routines and to expand the monitor. The CPU also contains a single step capability for debugging software.

When we got to the Mother Board, we really made progress. It has 14 slots to give you plenty of room to expand your system to full memory capability, and is compatible with SS-50 bus architecture. Heavy duty bus lines are low impedance, low noise, and provide trouble-free operation.

With all this power and potential, the interface had to be something special. So instead of an interface address in the middle of memory, we put it at the top . . . which gives you a full 56K of continuous memory. Interfaces are strappable so they may be placed at any address. An interface adapter board is compatible with all existing SS-50 circuit boards and interface cards. All MSI interface cards communicate with the rear panel via a short ribbon cable which terminates with a DB-25 connector. All baud rate selection and other strappable options are brought to the connector so they may be automatically selected by whatever plug is inserted into the appropriate interface connector. Straps may also be installed on the circuit board.

To complete the system, we used an MSI 8K Memory Board which employs low power 2102 RAM memory chips and is configured to allow battery back-up power capability. A DIP switch unit allows quick selection of a starting address of the board at any 8K increment of memory.

If you're one of those people who understands the technical stuff, by now you'll agree the MSI 6800 is a better computer. If you're one who does not understand it yet, you'll be more interested in what the system can do . . . play games, conduct research and educational projects, control lab instruments, business applications, or just about anything else you might dream up that a microcomputer can do. The point is . . . the MSI 6800 will do it better.

The MSI 6800 Computer System is available in either kit form or wired and tested. Either way, you get a cabinet, power supply, CPU board, Mother board, Interface board, Memory board, documentation, instructions, schematics, and a programming manual. Everything you need.

There is more to say about the MSI 6800 than space permits. We suggest you send for more information which includes our free catalog of microcomputer products.

Building a better computer was not easy. Becoming the number one seller will be.

See the MSI 6800 Computer System at Personal Computing '77 - Atlantic City.

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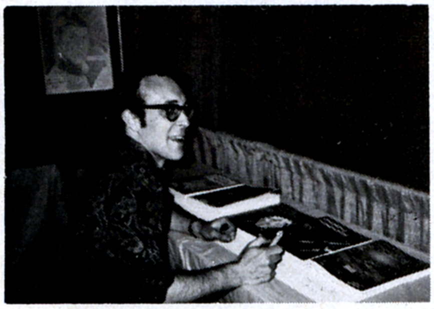
In which our publisher dons his reporter's hat and wanders around the Faire talking briefly to various and sundry people. Here it is: the color, the noise and the pagentry—unabridged and practically unedited! Are we for real? Judge for yourself.

The First West Coast Computer Faire

David H. Ahl

It's 3:30 Sunday afternoon April 17, 1977 and I'm standing here at the main entrance to Brooks Auditorium. Absolutely gorgeous sunny blue-sky day outside but not many people are looking at the outside weather. In fact the park across the street is virtually deserted. On the other hand, the entrance here to Brooks still has a line of people at the ticket window buying tickets for the first West Coast Computer Faire here in San Francisco. It first opened yesterday morning at 9 o'clock. At 8 o'clock in the morning the line waiting to get in was three-quarters of the way around the block. As of noon on Saturday 8,000 people had been admitted. Badges and programs had virtually run out and there was a momentary crisis. A new supply of both were obtained, the lines resumed inching forward, and the crowds continued well into the afternoon.

Today there were probably another 3,000 to 4,000 that weren't in the Faire the first day, thus bringing the total attendance to this first West Coast Computer Faire to 12,000-plus. (Official attendance was announced at 12,657.)


Peace and quiet Friday before the show opened, and time to finish a few signs.

As I walk into the main exhibit hall, both eyes and ears are assaulted with a variety of sounds. A number of music and speech synthesizers are all playing and talking at once. In addition, many people have displays using Advent projection-tv devices so that there's a virtual kaleidoscope of colors and sounds throughout the exhibit hall. This late in the day it's still difficult to move up and down the aisles. The aisles are crammed wall to wall, with four to six people deep around each booth. I found earlier it took an average of 15 minutes to get into a typical booth to talk to anybody in depth. There are approximately 140 booths in the main convention area and another 30 booths, actually mini-booths, around the outside of the main room—175 exhibitors in all.

I've just spotted Jim Warren, organizer of the whole show. In your own words Jim, how would you describe it?

Warren: A mob scene.

Ahl: A little overwhelming. What's the estimated attendance?

Warren: Yesterday evening we had in excess of 8,000 people and we've probably gotten another couple of thousand today. There's been a fairly steady stream through the ticket booths today so I would guess that we're pretty close to 10,000 people which is really pretty much what we expected. [As noted earlier, actual attendance was over 12,000.] But 10,000 as a number is very, very different than 10,000 walking, talking computer freaks. That's for sure. This was a mob scene. I think 95 percent of the people were just excited and really had a good time and it has really been a good day. It's also very definitely been actively characterized as a home-brew convention. That is, it was a convention which was home-brewed. We had a lot of various problems which we just didn't know what to do about, but I think we've learned a lot this time. But I think 95 percent of the people who have been here have been really excited over it.

Ahl: Are the exhibitors pleased?

Warren: As far as I can tell, almost everybody is really pleased. With the imperfections in the operation that we've had, people have nonetheless been patient and calm and seemed to enjoy what they were doing and even enjoying standing in line coming in just reading the programs and reading a copy of the *Silicon Gulch Gazette*.

Ahl: Are you planning to make it an annual event?

Warren: I don't know. Probably so. It would be terribly wasteful for us not to do it at least one more time because there's been such a tremendous learning process this time. For five months we

"One game of Tank War coming right up." Cromemco's Z-2 system was a major attraction at the Creative Computing booth.

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BIONIC

Continuous mobs during the two days of the show. Exhausting, but also exhilerating!

have been feeling, "By God I can't get enough help." You know, there's just too much to do. And there's been a tremendous learning period. We've learned so much now as to how to put on a good show that it would be very foolish of us to not do it again. It would be very wasteful.

Ahl: Can you afford the time to do it again?
Warren: With a year's lead time, which we would have, possibly so.
Ahl: As publisher of *Dr.Dobbs,* how do you justify so much time for the Faire?
Warren: *Dr. Dobbs* has always been a part-time activity. I'm a computer consultant; I have been for about ten years, and it just so happens that the last five months I've been consulting for the Computer Faire, which happened to be my own company.
Ahl: Will you make enough money on this to justify the last few months?
Warren: I had a pretty low salary, based on an hourly rate. But the point of doing this wasn't really to make money. I mean, back in the 60's we had happenings in San Francisco, and San Francisco was meant for that, and this is just another variation on it except it's a decade later. Back then it was power to the people and now it's computer power to the people.

Ahl: Thanks, Jim.

As I walk through again to the exhibit hall, my eyes and ears are assaulted with sounds and sights. And people! It's wild! Here at the beginning of the 100 aisle on my left is the two-booth display of Polymorphics Systems—a beautiful professional display. In contrast to that, right across the aisle, Component Sales, Inc. has a booth with polybags of all types of components, keyboards, chips, and even tape drives out on the counter. People are clustered around three deep and buying up everything they can get their hands on. Next to Polymorphic is a booth from Teletype Corp. which seems to indicate that even some of the large and well-established companies are beginning to recognize the hobbyist computer market as a viable market. Teletype is showing the printer from Dataspeed 40 as well as the new KSR 43 terminal and the old standby ASR 33. As I proceed down the aisle there is a small one-board computer system from Western Data Systems. Across the aisle is a display from TSC Software showing tapes of compilers, interpreters, and game packages for the 8080 and 6800 systems. Further down the aisle is Northstar Computers with their floppy-disc system, across from a display of the American Radio Relay League. Somewhat surprising a little further on—*Datamation* magazine. So not only are large manufacturers such as Teletype Corporation represented, but large industry publications like *Datamation, Computer Decisions, Mini-Micro Systems* are here too.

In the corner at the end of the first aisle is a large booth put up by the Byte Shops—with an assortment of books, computer systems, and peripherals. In addition, many of the individual Byte Shops and other computer stores in the area have booths throughout the hall. Then another large booth of Jade Co. doing a landslide business selling electronic components. Looking up in their booth they have a big sign, hand-lettered, "Sunday Show Special - 10% off on every item on the table." 2708 PROMS turn out to be a big item and many companies are selling them here at the appropriate price of $27.08. Around the corner is a booth for E&L Instruments. Across the aisle from them is a display called the Body Microcomputer, which is actually a long T-shirt being nicely shown off by some rather shapely girls in front of the booth, modeling it.

Going down the 200 aisle we see booths from Motorola Semiconductor showing their popular 6800 chip and associated drivers and circuits. Next is a Japanese display: Sord Microcomputer Systems, who appear to have a complete microcomputer system with floppy disc and terminals. IEEE *Computer* Magazine has the corner display diagonally across from our own *Creative Computing* display. People at this point—it's around four o'clock Sunday afternoon—are still three deep around the *Creative Computing* display. There's a mob of young ten-to-twelve-year-old kids gathered around the Cromemco Z-2 computer system running a new game called "Tank War"—two tanks maneuvering around on the screen, firing at each other with appropriate sound effects as the bullets hit the other tank. Some of them (kids, that is) have been there all afternoon and still show no sign of losing interest. Cromemco very kindly loaned us a Z-2 system with TV Dazzler and two joy-sticks. We've been alternating between Tank War, Chase, and Space War all weekend the system has been completely reliable.

Here's Howard Fullmer and Gene Nardi of Parasitic Engineering. (Parasitic is showing their Equinox 100 computer system for the first time here.)
Ahl: What do you think of the show?
Fullmer: It's incredible, all the people we've had here.
Ahl: Every time I've been past your booth there have been at least five people around it and I've had a heck of a time getting in to see your system.
Fullmer: We really haven't had that much time to observe because we've spent all of our time over there talking to people.
Ahl: What kind of people are you finding are interested in your system or what kind of people are you meeting here in general?
Fullmer: Well, of course, all the dealers are interested in our new system. but also, we've met a lot of people who have never thought about computers and just came by to see them. They show a lot of interest in how to program one of these—what does all this software mean and what do I need to get going? I want to write a simple inventory package for my business—how do I go about doing that? So, small-business people, hobbyists and a lot of curious novices. But just about everyone here is interested in a personal computer, deeply interested.

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miconduc

Big companies were well represented at the Faire.

Ahl: Are people going to buy this year or consider?
Fullmer: I think this is a faire of people who want to do something now—they're not all waiting for the $500 Commodore. They're a lot more together than that. They understand that there are a whole lot of different ways to go and they're looking at all of the ways.
Ahl: Are you having a good reception to your new system?
Fullmer: Oh absolutely.
Ahl: Do you think you're really going to get off the ground?
Fullmer: Yes. The kind of comments we've overheard are people saying, "You've got to get over and see that one!"
Ahl: So you think it's going to be a different kind of magnitude than selling power supplies and clock-fix kits.
Nardi: Yes, definitely!
Ahl: Can your production line keep up?
Nardi: Ask me after sx months, but we obviously think we can or we wouldn't be doing it.
Fullmer: We've built the company from literally nothing and it's been just fantastic.
Ahl: You're going to continue to call it Parasitic Engineering, right? Even though you're not parasites anymore.
Fullmer: Well, we thought we'd call it the Equinox 100 by Parasitic Engineering so we can go either way.
Ahl: Thanks, and good luck! Turning around who do I see but Ted Nelson. Ted, what do you have to say about this Computer Faire?
Nelson: There seems to be a lot of it and what I've seen has been choice. I think we've seen here that the computer world has suddenly broken in two. There's the straights and a strange coalition of hobbyists and the most technically competent and ambitious people throughout the field. A remarkable coalition that is going to do remarkable things.
Ahl: What do you think of the speech and music systems around?
Nelson: Just lovely! By the way, when's my comic strip coming out?
Ahl: Next issue, May-June. Our printer is on strike but we have another one and hope to have copies for the Trenton Fair. Turning around, who do I see, but Lou Frenzel of Heath. Lou, I see by your teaser ad you're announcing a couple of computers and several peripherals.

Vince Golden of Mike Quinn Electronics models a Godbout T-shirt.

Frenzel: Actually three computers, depending on how you classify them. Two of them are definitely full-blown general-purpose computers; the other is not. The line of peripherals will be quite complete—naturally there'll be some missing gaps in the beginning but you can't do everything at once.
Ahl: Will any of them be offered assembled?
Frenzel: No. Trying to get a wired product approved internally is close to impossible. Not that it can't be done, but we're a kit company and that's what we do best.
Ahl: We're all looking forward to seeing your products too.

As I continue down the aisle to my right is the Midwest Scientific Instruments booth. Jim Warren has just announced over the loudspeaker system that the top-dollar-value door prize, a floppy disc of Midwest Scientific, was just won so there's quite a crowd around the booth waiting to see the winner show up. Across the aisle is a display by Ohio Scientific Instruments with a beautiful color TV display, the OSI Challenger and floppy-disc system along with several other systems, all running and looking quite handsome. As I continue further down the aisle—I'm having a little trouble getting through—there's a huge crowd gathered around the Digital Group display on one side of the aisle and across the aisle Southwest Technical Products with an equally large crowd of people gathered around. As we continue on into the next aisle we find Apple Computer, once again with a beautiful display: an Advent projection TV device showing color graphics. Apple is demonstrating for the first time at this show the Apple II computer system. Here's Mike Markkula, Vice President of Marketing of Apple Computer.
Ahl: Are you pleased with the attendance here?
Markkula: Yes.
Ahl: Wildly or just mildly?
Markkula: In terms of numbers—wildly, but in terms of the reasons for their attendance, I'm not sure exactly why so many people are here. An awful lot of them are just plain curious as to what's going on. I'm surprised that a lot of them spent the price of admission, but I think they've all enjoyed it. I expected a few more people on a higher knowledge level. I'm very surprised at the whole thing.
Ahl: I would guess the Apple II would be suited to the kind of people that came to the Faire.
Markkula: Absolutely.
Ahl: You've got essentially what you call a black-box computer. Self-contained. You don't really have to know anything except how to hit a switch. What type of market are you aiming at? Somebody that wants to do programming, play games or what? Anything specific?

Constand crowds jammed the TDL booth to get a glimpse of newly revealed Xitan system. Donna Galleti of TDL talks with visitors to the booth.

Markkula: All of the above and more. We really want to be *the* computer company, not the small-business computer company or something else—just the personal computer company! So that's the reason you see a molded plastic case, BASIC in ROM, and so on. In fact we want to extend the whole concept to make it even easier to use.
Ahl: I noticed that your demos use various types and even color graphics. Is that all in your BASIC?
Markkula: It's all in the BASIC. We have COLOR EQUALS, PLOT a horizontal line, PLOT a vertical line, PLOT a point, etc.
Ahl: That's some BASIC! What size is it?
Markkula: 6K. It's an interpreter. It's also got a feature that nobody else has. We can have variable names any length up to 256 characters.
Ahl: I assume it has string manipulation and functions?
Markkula: Yes, string functions and matrix manipulation.
Ahl: What's the MPU chip in the Apple II?
Markkula: The 6502. It's the most efficient chip for what we're trying to do.
Ahl: What would a complete Apple II system require in terms of memory for the beginner?
Markkula: 4K is more than adequate. Remember the 4K that comes with a standard minimum system is all user space because the BASIC is in ROM. So almost all of the 4K RAM is available for programming and data.
Ahl: What would a system of that configuration cost?
Markkula: $1,298.
Ahl: Is that assembled?
Markkula: Assembled, tested complete with two game paddles and a complete carrying case so you can carry it around—all the cords and manuals and operating information.
Ahl: The "paddles" are those things that look like joysticks?
Markkula: Yes. You can hook up four paddles or two joysticks and pushbutton inputs. You can have all kinds of output, to a speaker for example. In fact, there's a speaker already on the board, although you can add four more in each of the paddle boards.
Ahl: When do you start making deliveries?

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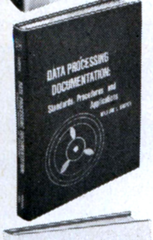

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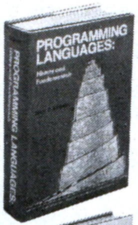

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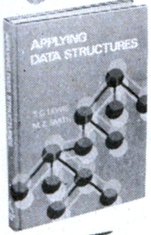

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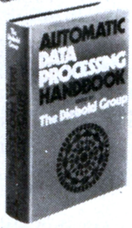

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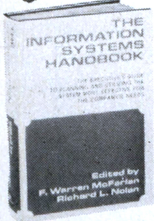

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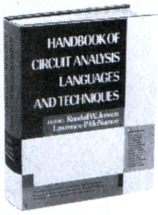

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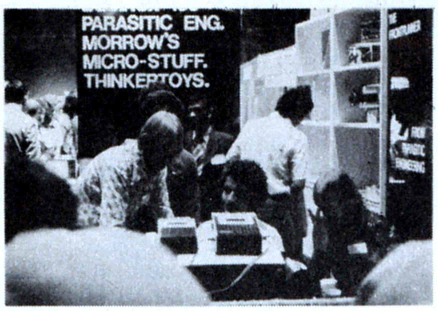

PARASITIC ENG.
MORROW'S
MICRO-STUFF.
THINKERTOYS.

Howard Fullmer (left) and Gary Fitz (center) of Parasitic Engineering demonstrate the Equinox 100 computer.

Markkula: The end of May.
Ahl: Thanks, Mike.

Continuing down the third aisle we find a huge triple booth of *Byte* magazine. Behind the table Virginia Peschke, the publisher, acting in the role of a salesperson.

Ahl: Virginia, what do you think of the show?
Peschke: I think the show is just great—marvelous. It's dynamite. And my feet hurt.
Ahl: I know what you mean!

It's very late in the life of the show—4:30 on Sunday afternoon and the show closes in just half an hour—and yet people are still three and four deep around every demonstration machine at the Processor Technology booth. The SOL computer is generating a lot of interest; one of them is hooked up to a music generator which is making very interesting sounds and generating a lot of enthusiasm among people attending the show.

Walking by the Prime Radix Booth, one's ears pick up the sounds of Handel and Bach coming out of a six-channel music synthesizer board just introduced by Prime Radix.

Over in the next aisle we have People's Computer Company and Dymax next to each other. Right next to them is Computalker Consultants who have a speech synthesizer playing a rather clever saying—"Hello, I'm Computalker, the speech synthesizer designed to plug into the standard S-100 bus on your 8080 microcomputer." The Computalker allows a variation in the speed without altering the pitch of the spoken word. A very interesting concept.

Next is the Parasitic Engineering booth with the Equinox 100 Computer System—those were the people we were chatting with earlier of Parasitic—and people still at this point are gathered four deep around that new computer system.

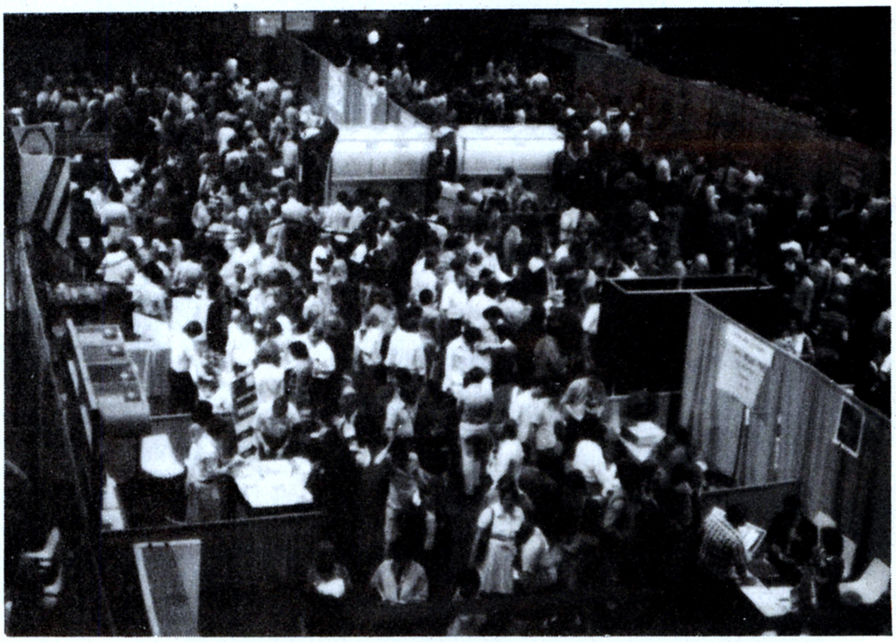
Continuing on into the next aisle we have Cromemco running very much the same games that we were running on our Z-2 system at the *Creative Computing* booth—tank war, space war and a chase game. Once again an army of young children playing these games on the dual joysticks. Continuing down the aisle we have a new company called Smoke Signal Broadcasting which has SWTPC 6800 compatible peripherals. Across the aisle ICOM with their mini floppy discs and right next to them Micro Designs with a cassette recorder. A little bit further we have Galaxy Gystems with still another kind of music synthesizer. Across the aisle from them, Godbout Electronics with various types of components and S-100 bus peripherals. Next to Godbout is National Semiconductor with beautiful chrome fixtures and blue carpeted booth—once again demonstrating the commitment to this hobby by some of the very large manufacturers.

A few moments ago I met Bob Davis. Bob is with Intel, Microcomputer division. His job is "manager of hobby marketing and personal computer products." So, a company like Intel, the leading chip maker, has a manager for the personal computing movement! Aha!

At the end of the aisle is a company called Heuristics Inc. with a new product called the Speech Lab. The Speech Lab is the first peripheral that permits a computer to recognize speech (for under $300!).

Continuing on down to the next aisle we have a huge crowd gathered around the Mr. Calculator booth. This is the place where the rumored Commodore system is being shown. The $500 computer with 12K memory, cassette and TV interface, and keyboard is self-contained in a small cabinet. If the $500 price comes true it would certainly be a revolutionary development in the whole field. Approaching me now is Lou Fields, President of the Southern California Computer Society.

Ahl: What do you think of the show?
Fields: Well, I didn't have enought time to see everything that I wanted to see but I thought it was very good.
Ahl: Did you attend the sessions?
Fields: I attended some sessions. But in terms of the sessions I really think the stimulation is getting to talk to people individually. You have the people around here who designed the equipment and who are the creators in this field and they're here at the booths. I think that's enormously valuable in terms of the catalyst of this whole thing.
Ahl: I assume that SCCS has pretty good representation here.
Fields: Yes, I've seen a lot of our members.
Ahl: How many members are there currently?
Fields: We have about 8,000 members around the world. We have chapters in firms and communities in California and now many communities as well around the world including Mexico City and Tokyo. I think small-business applications are going to be even more important out of the country then they are within the country.
Ahl: You spoke of the members outside of California—how about the members in the Southern California area where it started? How many—what percntage of the membership is there?
Fields: I'm not sure of the absolute numbers but I guess off hand that it's probably about somewhere between 2,000 and 3,000.
Ahl: So of the 8,000 total, at least 5,000 are scattered elsewhere. That's very interesting.
Fields: Yes it is, and of course our name is very misleading and we've been considering something that's been more accurate. We did a poll this month to see



View of the West Coast Computer Faire from above

After the Faire, the breathtaking California coast provided a welcome change of pace, particularly for the out-of-state visitors.

what the members felt about that. Many of them feel we should change the name to something more appropriate, and I think we will.

Ahl: I would think that many members outside of Southern California might be pleased to be associated with the SCCS name.

Fields: Well, some of them are. Some of them find it charming and quaint but a lot of others are very annoyed by it and they have negative feelings that "Oh, Southern California is a junk society and we don't want to be involved with that." So there are two sides to the coin—there is the glamour and the fact that the bulk of the small computer industry is located in Southern California.

But I think if you want to know where the most important area is in the country for members and microcomputer activities I'd say Philadelphia. It's not in California—it's in Philadelphia. Draw a fairly small radius around the eastern states and you get two-thirds of the population of the United States. So on that basis, Southern California is insignificant.

Ahl: However, we're probably not looking at the whole population - we're really looking at a demographic subsegment.

Fields: OK - so there are a lot of ways of looking at it. The people active in the field today are certainly clustered in California and half a dozen other places. But in terms of the real bulk of the people who are *ever* going to be active in this field, it is your area (East Coast) that I feel has the most potential. You've got the bulk of the universities, the bulk of the manufacturing companies of all kinds, and the bulk of the people.

Ahl: Well, you're right. As the population at large gets drawn into the movement, yes, it's certainly going to shift to the population centers.

Fields: That's inevitable. It will. You have something developing actively in a given area because of a few individuals, really. It developed in the Los Angeles area initially because of the interest and actions of Don Tarbell and that's where it started. Do you know the history of the SCCS?

Ahl: No. Please go on.

Fields: Well, Don Tarbell was an engineer at Hughes who was into hardware and software design. He went to the MITS caravan and got an idea for this audio-cassette interface board. he designed that and then went to sell it—not as a board but as a set of plans. He put a small index card up in one of the local electronics stores offering the plans for $2. I walked in and said, "Gee, that sounds interesting." So we met at his house with a bunch of other people and that's how it all started. It really started with the judge of the superior court of the local area who was a ham and went on from there.

Ahl: Very interesting.

Fields: It's an individual thing. I don't think things happened by committees anyway. Like yourself—you created this fantastic magazine and you've done an incredible thing. I'm sure you haven't done it because of 40 other people who wanted to get into it. It was your own inspiration, it was your own genius and knowledge that put it together. And that's the way the whole industry is going.

Ahl: Thanks, Lou.

I had hoped to get Sandy on here but things are still hectic at our booth. Sandy, my wife, was helping out here at the booth along with a number of college students I had recruited via the timeshare computer network at the University of San Francisco. While they use the timesharing system, most of the students there had very little idea what pesonal or hobbyist computers were all about and coming to the show was a real eye-opener for them.

One interesting observation Sandy made is that most of the people involved in this industry are young late twenties or early thirties, from programmers and designers to presidents and founders of companies. We're dealing with an industry that appeals to the young at heart. Even more, it inspires the entrepreneurial spirit in people. This is something that has been dead, in my opinion, for a long time in the United States. Many college students today are looking for a secure job with an established company; they're not seeking a position where they have a lot of risks or where they're putting their own judgments on the line. Yet in this new hobbyist, personal-computer field, it's innovation, creativity and individuality that really count. These personal qualities are rewarded in this field. Hobbyists are a very intelligent group and are looking for the company and the product that offers more than the competition: consequently the entrepreneur with an idea who is willing to take a risk to bring his innovative product to the market is, in the long run, going to be a winner.

What were the most significant elements of the Faire? Why was it different from Trenton a year ago or from Atlantic City last summer? Well, of course, it was bigger, with more exhibitors. The sheer size of the hobby, the attraction to the general public who were not directly involved in the hobby but were interested enough to come to the Faire and find out what was going on. The tremendous diversity of the sessions which dealt with people and computers, legal aspects of personal computing, art and music, video art, computer systems for small businesses, computer networking, speech recognition and synthesis, amateur radio in computing, and multi-tasks on home computers. Also an extraordinary variety in the home-brewed exhibits. People who have taken electrical components, bits and pieces from the commercial kits and assembled them into not just a breadboard computer but a living, working, breating home computer for some purpose, whether it be for video art or some other purpose.

As Jim Warren said earlier, we can expect a repeat next year, only bigger and better. I would expect other Faires or conventions or festivals also to be bigger and better as the hobby grows and flourishes. So watch these pages for notice of the next one and go yourself! ■

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THE MICROCOMPUTER PEOPLE

Featuring an interview with Dennis Dupre of ECT

The Second Trenton Computer Festival

Stephen B. Gray

On May first last year, over 1,500 people crowded the narrow and dimly lighted halls of a building at Trenton State College, to look at the hobby computers and peripherals displayed by 45 exhibitors. At the flea market out in the parking lot, you could buy almost anything from a capacitor to an ancient tape drive. In various classrooms, papers were presented on hardware, software and applications. This was the first of its kind every held, the Trenton Computer Festival, sponsored by the Amateur Computer Group of New Jersey and the college.

Many improvements were made for the second festival, such as spreading it out over two days, April 30 and May 1. The burden of running the show was shared with the Princeton chapter of the IEEE and the Philadelphia Area Computer Society.

The exhibitors, although still only 45 in number, were no longer limited to a single booth space; this year, some had four. All were in one large, well-lighted room, providing enough space for the 4,000 attendees to move easily from one booth to another. Speakers were given more time for their presentations, which were recorded on cassette, duplicated, and put on sale within a remarkably short time. There was a banquet, well-attended, with John W. Mauchly and his wife as speakers.

Many of the exhibitors were local computer stores. Attendence was heavy at the innovative multi-part display put up by the Computer Mart of New Jersey. Called "Computers in Action," the displays showed various uses of computers: a SOL used for game-playing, two Fairchild games connected to color TV sets, a lab setup with a digital voltmeter hooked up to a Poly 88 and a TV set, and a businss application showing how a dentist could use a computer to print the information required for an insurance claim. One of the hits of the show was the Computer Mart's setup of an Intecolor 8001 with light-pen, for eight-color graphics.

Motorola underestimated the demand for their brochures on the D2 kit, and ran out of them early the first day.

A count of computers showed twelve Imsai, two Altair, two SOL, and three Southwest, in addition to the new computers on display.

A talk on the Commodore PET (Personal Electronic Transactions) computer drew a large audience. This $495 plastic-cased computer will be sold ready to run, with 12K of ROM holding 8K BASIC and 4K OS, 4K (or 8K optional) RAM expandable to 32K, built-in audio-cassette mechanism, 64-character graphics set on 8x8 matrices in ROM, keyboard, 6502 MPU, 9-inch TV screen, string functions, optional printer for 8-inch paper at $500, with future options to include floppy disk, Focal and Fortran. PET is due in September at large-volume retail outlets such as Sears, Radio Shack and Penney's and some of the larger computer-store chains.

Another highpoint of the show was the Technical Design Labs Xitan computer, which manages to cram quite a lot onto three boards in a small case (look for it in the Catalog pages). TDL has been manufacturing boards that plug into the S-100 bus of other companies' computers. The Xitan is their first computer, and is thus the sum of their work to date.

The Xitan *alpha* is the starting point of a family of computers, all using the S-100 bus and some boards in common, according to TDL. Models will be designed to "fill different market niches," for varying applications. TDL plans to offer I/O devices, mass-storage units, a word-processing option, and many more items that are still under wraps.

Also attracting a lot of attention was Electronic Control Technology's display of a microcomputer system. The components, all available separately, consist of a rack-mounted frame for S-100 cards, prototyping board for hand-wiring, memory board, and CPU board. Managing Editor Burchie Green and I interviewed the president of ECT, Dennis Dupre.

Gray: How did you get started in this?

Dupre: It started around 15 years ago in high school. I was interested in electronics. I started designing audio circuits for hi-fi equipment. I always had an interest in electronics, in special circuits, security systems. I went to college and became an engineer in electronics, at Newark College of Engineering.

Gray: What year did you get out of there?

Dupre: 1970.

Gray: So what was at first a hobby led you into a professional interest so you studied it in college. And what happened then?

Dupre: I worked for several companies including Lockheed Electronics, Quindar Electronics, a small company called American Electric Controls, a large company Wallace & Tiernan (a division of Pennwalt), National Multiplex and then I started my own company.

Gray: You started your company how long ago?

Dupre: About two years ago.

Gray: What did you feel you had to offer that was unique?

Dupre: At that time I bought the Altair 8800 and I saw how bad their memory board was—the 4K dynamic memory board—and decided to design my own to go into the Altair and designed different boards for that computer and am now coming out with a big system of my own using the S-100 bus.

Gray: What other products did you come up with after the memory board?

Dupre: A prototyping board for hand-wiring, as opposed to most of the rest of the market being for wire-wrap. Selling prime-quality components to the amateurs in New Jersey.

Gray: Do you mean selling just to the amateurs in New Jersey?

Dupre: Not just New Jersey but the main market by attending all of the amateur computer group meetings.

Gray: And you made known at these meetings what you had to offer and that's how you spread the word around of what you have available. At what time did you start advertising? Was that when you only had the one board at first? Did you wait until you had several?

Dupre: Well there were two boards, the prototype board and the memory board. That was January of 1976 when I started advertising.

Gray: So there's the memory board and the prototyping board and what came after that?

Dupre: The card-cage mother board, and the 8080 CPU card.

Gray: You say card cage. That's the basic frame for a S-100 system?

Dupre: Correct. A 19-inch rack more geared toward the industrial market or the hobbyist who wants to supply his own cabinet starting off with a minimal system and building with parts that he already has. Like ham operators normally have a lot of transformers and capacitors, stuff like that, so they don't want to pay additional money for power suplies and they build their own. This offers a cage to put the cards in, a starting point, and they can build from that.

Gray: So that was the third product, the card cage. And the fourth one is the mother board, that's part of the card cage. Can it be bought separately?

Dupre: Right.

Gray: And the last thing you mentioned was an 8080 CPU board. What's different and good about it that isn't available elsewhere?

Dupre: It's designed for running without a front panel. The rest require a front-panel operation and this one does not need a front panel.

Gray: Why? Does it have a monitor in it?

Dupre: It has a jump-to type of circuit built onto the CPU card that can be used with a ROM monitor. No ROM monitor on the board. That takes another board.

Gray: Are you considering supplying that too?

Dupre: Yes. That's one of the future products. We are presently recommending the National Multiplex 2SIO(R) board, a cassette operating system.

Gray: So is this the latest board then, the CPU board. And next you're considering what?

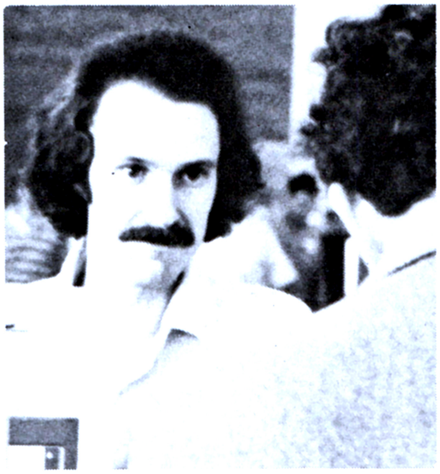
Dupre: A 16K RAM board is the next scheduled.

Gray: Anything else we can talk about for publication?

Dupre: Two other products scheduled for the summer of this year are the Z-80 CPU card and a board with 2K RAM and 2K ROM which can house a ROM monitor. These are all S-100 types.

Gray: So before long you'll be able to supply the whole computer. Will you sell it as a system?

Dupre: Yes, later this year. The future after that is more industrial, toward the process-control industry.


Dennis Dupre of Electronic Control Technology

Gray: Using these same boards? A turnkey system?

Dupre: Yes. A turnkey system, dedicated controller.

Green: Why are you putting in all this enormous amount of work and energy and time?

Dupre: It's sort of a personal ambition at this point in time to develop a complete microcomputer system. I've always had the ambition to have a company of my own. This field seemed to be a good starting point. Develop the company and get it known and expand into the industrial market.

Green: Basically you are an inventor, that's where your interest lies, and yet you are trying to capitalize your own inventions. Basically what are the big disadvantages that you see in that?

Dupre: It's not really disadvantages. It's just that I'm trying to take the hobbyist market and all the different companies, all the different boards available and try to make them more available to industry, producing additional boards and basic systems which are more useful to the industrial process-control type of instrumentation.

Gray: How would you handle the complicated business of maintenance on these items if they were sold? Would you leave that up to the individual?

Dupre: It would all depend upon the nature in which it was sold. If it was sold as a system it would be sold with either a specific contract similar to industrial terms of maintenance or repaired as needed. We'll eventually have complete repair facilities.

Green: Have you started with this or is this what you are working on now?

Dupre: This is what I'm working up to. This microcomputer system that I'm just coming out with now will be the basis, the starting point, of a big system.

Gray: It will be sold two ways - to the hobbyist and as a turnkey system for the industrial market?

Dupre: Right. As a turnkey system to computer stores who in turn resell a bigger system with software. The computer stores would set up the software for individual needs.

Gray: Do you have any time for other interests?

Dupre: Not when going through a college like Newark College of Engineering.

Gray: But now do you have any time?

Dupre: I like to go camping, go into the backwoods like on the trip to California to the San Francisco Show. I took a day or two off to go to Sequoia and Yosemite. I prefer going back to nature every once in a while.

Gray: How old are you?

Dupre: Another two months and I'll be 30.

Green: You are brilliant and you've been working hard on a system but you're working as a company in a field where there is a lot of talk that very soon many of the companies will not be able to survive because Heath and Commodore and some others can offer cheaper systems. How do you feel this affects you?

Dupre: Their market and my market are not exactly the same. They are looking specifically for the home market and I am looking more toward industry and special-purpose systems where even if these other companies come in with very low prices, industry will not use them because they will not take the time to design to the specific requirements that process-control would require. Smaller companies are always needed to fill those gaps, to do these specialized systems. Only one or two of the specific type of system might ever be made, and Heath and the other companies would not go for a one-shot type of system. At the present time only a couple of companies are making a couple of boards which are supposedly for industrial control. As far as I can see none of the other companies have really been in the process-control industry and what they are producing is only touching the surface of what is really required for industrial process control. ■

Der Doctor.

Medical Computerized Data Bases

by Susan Hastings

The computer stands at the threshold of the entire health care industry. It already controls many administrative functions. Doctors are using it to make diagnoses and to simulate surgical procedures. Comprehensive medical data banks have already been established in this country. With national health insurance just around the corner, computer use is exploding throughout the healthcare field.

Those who object to the increasing use of computer systems in medicine say that it will destroy some of our most sacred institutions, including the confidentiality of the traditional doctor-patient relationship. They believe that medical computers pose a great threat to privacy because they contain information required by so many other agencies; they feel that once patient records are put into computers which will make information accessible from remote terminals, there may be no limit to violations of privacy.

We should remember, however, that the computer itself is only a tool. And while tools can hurt us if not used sensibly, by definition, their prime use is to benefit man in controlled situations. Technology is continuing its search to develop devices that will improve the control man holds over his newest, and maybe most powerful tool, the computer.

"Security" is the technological term given to the devices that will help to insure the privacy of information once it is contained in a data bank. The computer is capable of providing security to the medical community in safeguarding its records and its traditions of confidentiality, and the new government legislation will regulate the kind of information that may be collected in data banks. Efforts like these to insure a patient's privacy actually make the medical information stored in a computer seem less vulnerable to invasion than information stored in a doctor's file cabinet or on a medical chart in a hospital.

The health care industry does have a responsibility to establish the proper administrative procedures and use the available security devices to protect privacy. The revolution in medical care brought about by the computer can lead us toward a radical realignment of knowledge and power where the controlling interests have little or no regard for human values. Or it can operate in the best interests of the entire health care community. If the computer is to become a trusted and productive member of the health care industry, its security must be maintained. Safeguards built into the computer itself will aid in protecting user privacy, as will ensuring staff honesty and dependability. A code of ethics to guide the medical profession in using computers would also inspire respect on the part of practitioners and trust on the part of the public. As health care itself, and the administrative functions necessary to good health care increase, the fact that the health care community can no longer exist without the medical computer becomes more and more apparent. We must now learn to use it in a sensible and humane manner. ■

The Placebo and the Computer— Unexpected Antagonists

A few years ago, a drug called reserpine became available for treating homicidal patients. St. Elizabeth's Hospital in Washington set up a trial to test the effectiveness of the drug. One group of homicidal patients was to receive the drug. Another group of homicidal patients was to receive a placebo sugar pill, which purportedly has no pharmacological effectiveness. Neither patients nor doctors involved in the study knew which of the two groups of patients would be getting which pill.

The psychiatric resident who gave medication to one of the two groups was Werner Mendel (now a professor of psychiatry at the University of Southern California School of Medicine). Shortly after the drug trial started, Mendel became convinced that his patients were receiving reserpine because they calmed dramatically. The more convinced he became, the more they improved. After the study was over, however, he learned that his patients had received the placebo. And that's when the power of the placebo first hit him. If a physician believes in a medication, he decided, he will transfer that belief to his patient, and his patient's condition will improve.

Many physicians, however, do not appreciate the power of the placebo and what it can do for patients. This charge is leveled in the June 23 *Journal of the American Medical Association* by Herbert Benson and Mark D. Epstein, physicians at Harvard Medical School.

There is ample evidence, report Benson and Epstein, that placebos can help patients with a variety of ills — pain, heart attacks, rheumatoid arthritis, hay fever, headache, cough, peptic ulcer, anxiety, depression. It is precisely because of this evidence, they argue, that physicians should look into how placebos work and exploit them to full advantage.

Only when physicians better understand the scientific basis for placebo effectiveness, Benson and Epstein conclude, will they be able to incorporate advantageously the placebo into evolving forms of health care. They are concerned that taking patient histories by computer will not allow physicians to develop the rapport with patients that is necessary to heal them. ■

Selecting a Micro

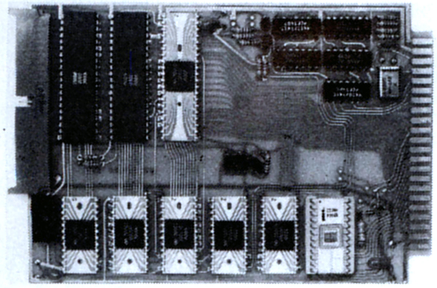
Stephen B. Gray

Selecting a hobby computer is getting harder every month, with new micros coming on the market all the time. Over 50 are available now, in kit or assembled form, or both, with a wide range of prices, and a great variety of features and peripherals. Some of the later ones have features that the earlier micros didn't, which may well cause some hobbyists to say, "I'll wait until a better machine comes along." That's a little like waiting for the *perfect* car, or stereo (or mate, for that matter). In waiting for that peak of perfection, you could lose out on a lot of fun and games (especially the games, in the case of micros).

The choice can be narrowed down by considering the various types of hobby computers. Five types dominate the market today, each with its own characteristics and appeal.

Type A: PC Board

The simplest hobby computer consists of a single printed-circuit board. This type was first sold for "engineering evaluation" (and many still are), to companies thinking of incorporating a microcomputer in one or more products. What you get is the central processor unit (CPU) board, which includes an MPU (microprocessor unit) as the main integrated circuit, along with control circuits, input/output interfacing, and perhaps some memory.



Type A: Wintek Control Module

Since the Type A micro is a minimum machine, you have to provide a power supply, facilities for input/output (such as a Teletype, or at least a keyboard and readout), and enough memory to allow the computer to run the programs you want, in the language of your choice.

With only IK or less of memory, your micro is limited to being programmed in machine language, or to short programs in assembly language. Some computerniks find both languages fascinating, but most hobbyists find them tedious and easy to make mistakes with. There's a lot to be learned in working up the ability to use an assembler fluently, but most of us are more interested in programming than in working that close to the hardware.

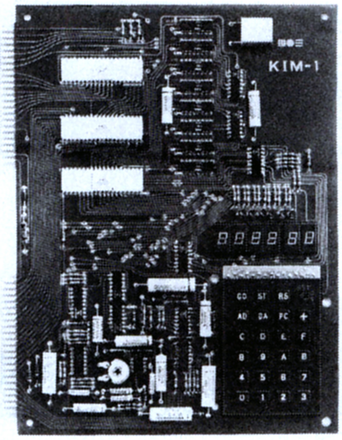
There's Tiny BASIC, a high-level language that makes programming much easier than with assembler, but if you try to use it with the limited amount of memory that comes with nearly all the Type A microcomputers, you won't have much memory, if any, to use for your own programs. This is because the Tiny BASIC itself takes up a certain amount of memory space, such as 2K. So you buy more memory, perhaps enough to run full-scale BASIC, for which you'd need at least 4K of memory for the BASIC interpreter itself, and at least 4K more for your own programs.

Examples of the Type A single-board computer are the Microcomputer Associates JOLT, and the National Semiconductor SC/MP.

Buy one of these Type A computers if you're more interested in hardware than software, are more interested in assembly language than in BASIC, and want to learn the fundamentals of computers. Type A is for the real computernik, as well as for the beginner who wants to learn all he can about hardware. It can be an inexpensive way to go, if you can keep down the prices of all the rest of what you need to create a usable system.

Type B: All on One Board

This type is one step up from the PC-board computer, because it adds an integral keyboard and display. The keyboard is almost always a hexadecimal type, with at least 16 keys labelled 0 to F, and perhaps several other keys for entering the keyboard data into memory, or displaying what's in a particular memory location, etc. The display in some of the cheaper Type B computers is made up of LEDs, which is not so easy to read; the majority provide a segmented alphanumeric display, with two, four, six or even more digits displayed.



Type B: MOS Technology KIM-1

Here is the most computer that can be bought for the least. Everything is supplied but the power supply, in nearly all cases, although some manufacturers provide one as an option.

With a hex keyboard and an alphanumeric display, the user can program in assembly language. Not very big programs, since most of the all-on-one-board computers are limited as to memory. But if you want more memory for your KIM-1 computer, you can get KIM-2, which is 4K, or KIM-3, which is 8K of memory. KIM-4 is a backplane into which memory (or other) boards can be plugged. For the EBKA 6502 Familiarizor, there's an expander board that will hold any or all of seven options, including a PROM programmer, 2K PROM memory, 4K RAM memory, baud-rate clock, and interfaces for dual cassette, serial and parallel operation.

More of the Type B computers are available than any other type, and include the MOS Technology KIM-1, EBKA 6502 Familiarizor, E&L Mini-Micro-Designer, Intersil Intercept Jr., EPA-68, and the Martin Research Mike 3 and Mike 8. All but the last two consist of a single board; Mike 3 and Mike 8 are stacks of several boards, separated by spacers. This modular approach, with the keyboard and display on the top board, CPU on the second board, memory on the third, etc., permits using different CPU boards with differing MPU chips, such as the 8080A, Z-80, or 8008, for the hardware (and software) experimenter.

An all-on-one-board computer is recommended for the person who wants the most for the least, or the person who wants to learn the basics but who doesn't want to spend too much on something he may not use much, once he's learned enough to satisfy himself.

The same situation with languages applies to both Types A and B microcomputers. With limited memory you can work only in machine language or assembler. With a little more you can use Tiny BASIC, and with 4K or more, you can start working in standard BASIC.

Type C: Box With Lights and Switches

The first hobby computer to achieve stardom was the MITS Altair 8800, which had a full front panel, with two dozen switches and three dozen lights. Most of the switches are for addressing memory and for inserting or retrieving data from memory; the rest are function switches. Most of the lights indicate the address or the data; the rest indicate functions.

Type C: MITS Altair 8800b

The Altair 8800b, the latest model of the 8800, includes some additional function switches. Several other hobby computers are compatible with the Altair 8800b; that is, a circuit card from any one of them will plug into the motherboard of any other. This includes the Imsai 8080, PolyMorphic Poly 88, and the Processor Technology SOL, which use what has come to be called either the "Altair bus" or the "S-100 bus" (we call it the Altair S-100 bus, just to cover all bases, or buses).

The Altair 8800b comes with no memory, so you'll have to buy some before you can start programming. As for other add-on options, there are more for the 8800b (and its compatible brothers) than for any other hobby computer—over 100 boards, from several dozen manufacturers, that can be plugged into the Altair S-100 bus, including memory, graphics, voice synthesizer, peripheral interfaces, etc.

Programs can be entered and run on the Altair 8800b without the need for anything other than the computer itself, although the hard way. You can enter a program, in machine language, byte by byte, by means of the front-panel switches, run the program, and then read the results by decoding the pattern of lights. However, this is suitable only for very short programs, and for occasions such as checking out the computer when you've just built it, or when you have problems with it later on. So unless you enjoy flipping toggle switches hour after hour, you'll need some form of input/output, such as a keyboard for input and a TV set (or other type of video screen) or a printer.

Other Type C microcomputers, in addition to those already mentioned, include the PCM-12A Electronic Tool Company ETC-1000, and the MITS Altair 680b.

All in all, with what you'll have to invest for the computer and for input/output, this is the type of machine to choose if you're sure you want to go further than just becoming familiar with computers, and if you're more interested in programming than in hardware. Also, it's the type to choose if peripherals are your thing, since so many are available for the Altair S-100 bus.

Type D: Box Without Lights or Switches

Are all those switches and lights really necessary? Not really, since there are very few microcomputer operations that can't be performed using a keyboard, if the computer has a monitor. This is a collection of relatively short service programs, stored in a read-only memory (ROM), that can greatly shorten the time required to get your programs written, debugged, and running.

One of the most important of these service routines is a bootstrap loader, which has to be fed to any microcomputer before anything else goes in, to guide the regular programs to the proper places in memory. Since the computer is a very fast but stupid servant, it has no way of knowing just where your programs should be loaded in memory, so the bootstrap loader is needed as a set of signposts.

Other monitor programs can include, as in the Southwest Technical 6800 computer, which is the best known of this type, routines for examining (and changing, if required) the contents of any memory location, printing or punching the contents of any memory location, displaying the contents of the MPU registers, and switching the computer over to running the user's program.

SWTPC 6800 COMPUTER SYSTEM

Type D: Southwest Technical 6800

Other computers of this type include the OSI Challenger, PolyMorphic Poly 88, Processor Technology Sol, and the Wave Mate Jupiter II. Most of these computers have only one or two switches on the front, usually one for power on/off, and another for reset. Just about the only function one of these computers can't perform, and which a Type C can, is to sense the position of a front-panel switch. That is, the program can ask, in effect, "Is switch 3 up or down?" in cases where it's easier to set one or more switches on the front panel than to have to change the program each time there's a difference in the conditions represented by these switches.

Just to confuse things, there's at least one computer, the MITS Altair 680b, which has both a full set of switches and lights, *and* a monitor in ROM. Incidentally, nearly all the Type B all-on-one-board computers contain a monitor.

The Type D computer is the way to go if you want a faster startup and the other advantages provided by a monitor. The monitor puts the bootstrap loader into memory as soon as the computer is turned on, or whenever you press the reset button, so you're ready to load your own programs. With a Type C computer, you'll have to key in the bootstrap loader by hand each time you turn on the machine, although this doesn't take too long once you've gone through it several times.

Because the Type D machine has only a couple of switches, it's somewhat cheaper to buy, on the average, and easier to put together; the Southwest

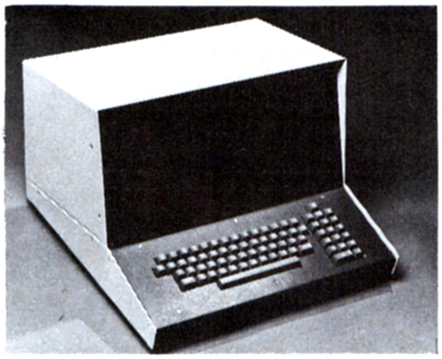
Technical 6800 is admired even by competing manufacturers for its ease of assembly.

Type E: All in One Box

With this all-inclusive type of computer, you get everything you need all at once, all in one box: computer, crt, and keyboard. Although this type is the most expensive, since it combines a computer and two peripherals, it does provide a complete package that lets you start programming right away, because most of these come with a monitor.

Computers of this type include the Compucolor 8001 and the Sphere 300 series.

This type of computer is important, because, in prewired form, it will probably become the most common "people's computer" of the future. More and more people who can't wire up a kit are getting interested in hobby computers. So this type is bound to be a best seller, since it comes complete and ready to use, with no add-ons needed unless the user wants more memory. A forerunner is scheduled to be on the market very soon: the PET 2001, made by Commodore (which owns MOS Technology, creators of KIM-1), with molded plastic case, keyboard with graphics characters, numeric keypad, built-in 9-inch video monitor, 20-line by 40-character screen, built-in audio cassette unit, 4K RAM, about 12K of ROM with BASIC interpreter and cassette operating system, all for $495. Production was scheduled to start July first of this year.



Type E: Sphere 310

Several of the larger hobby-computer kit manufacturers are considering wired-only BASIC models, at least two calculator manufacturers are working on prototypes of such machines, and even some of the business-computer makers are keeping a close watch on the hobby market to see if and when they should get into this fast-growing field.

L'Envoi

There you have the five main types of hobby computers. There are half a dozen other types, represented by one or two companies each, such as the computer built into an attache case.

Even with the guidelines we've provided, making a choice still won't be a simple matter. Write to manufacturers for information. If you can visit a computer store, let the personnel demonstrate their products, and they'll be happy to answer your questions. Join a computer club, and talk with hobbyists who have operating systems and whose experience can help you choose a machine that's best suited to your wants and/or needs.

Magazines and club newsletters are excellent sources of information—take a look at *Creative Computing's* "Equipment Profiles." If you can get to a hobby-computer convention, such as held in New Jersey (Trenton and Atlantic City), Cleveland, San Francisco, Atlanta, and several other cities, these are great places to check out dozens of computers and peripherals in a single day, as well as listen to lectures on hardware, software and applications.

Don't wait. Get in on the fun now. For as little as a few hundred dollars (or for as much as a few thousand), you too can become a micro maven. ■

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Psychiatric Assessment via Computer

by Susan Hastings

In traditional mental health admitting systems, the time required for a complete patient evaluation has usually strained both the staff and economic facilities of a hospital, and contributed greatly to the increasing inability to satisfy patient needs. One potential solution to the problem of implementing a sufficiently comprehensive evaluation may be found in the appropriate application of computer technology. The Salt Lake City Veterans Administration Hospital has been using a computer-assisted Psychiatric Assessment Unit (PAU) for two years in order to optimize assignment of patients into its treatment system.

PAU is an on-line computer system that functions in a real-time mode to collect, summarize, and interpret data. Functionally it is designed to: 1) gather extensive, standardized clinical data, 2) perform computerized analyses of these data, and 3) generate printed reports which contain statements regarding tentative diagnosis, an initial problem list, and other relevant clinical data. This information is then compared to specific admission criteria for each treatment unit in the mental health care delivery system.

Contemporary computer technology is of crucial importance in implementing this design, since it permits several radical departures from the usual psychiatric admitting practices. Specifically, by using interactive cathode ray tube terminals (CRTs) to display a series of multiple-choice questions, it is possible to collect information about psychiatric and physical symptoms, as well as extensive historical data, directly from the patient. The CRTs can also be utliized to "prompt" staff members as they perform standardized screening examinations to determine mental and physical status. And because the system is designed to operate in a real-time mode, clinical data can be analyzed and narrative reports gathered as soon as the assessment is completed.

A patient who is entering the PAU is greeted by a receptionist who enters basic identification into the computer system. He is next introduced to the Clinical Coordinator and briefly interviewed to determine whether he is able to complete the self-report testing. If, as is generally true, the patient's clinical condition is such that testing is possible at the time, a comprehensive evaulation process begins. The PAU coordinator administers a mental status examination recording data on a CRT, and a narrative report with a standard diagnosis is generated on a remote terminal printer located in the PAU office area.

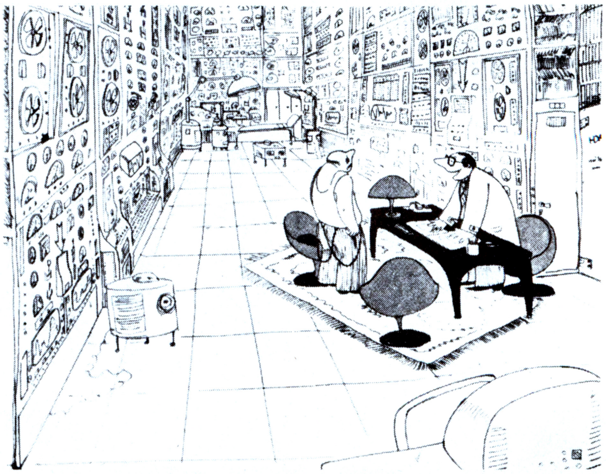
The patient is next instructed in the procedure for completing his self-report testing. The self-report tests presently used include a medical history questionnaire developed for on-line computer administration by Warner, the MMPI, the Differential Personality Questionnaire, the Shipley-Hartford Test for Intellectual Performance, the Briggs Social History, a problem list, and the Breck Depression Inventory. As each test is completed, the computer analyzes the responses and prints a narrative report. PAU staff then review all test reports and meet to determine an optimal treatment disposition for the patient.

Most patients complete the entire assessment procedure in approximately five hours. The great majority of patients seem to readily accept the process, and many believe that the assessment procedure itself is personally "helpful". Treatment for patients who have been admitted through the testing is available immediately, and because of a more adequate intake of information many more applicants for care can be admitted to inpatient status. Since PAU was established, the overall functioning of the mental health care delivery system in the Salt Lake City hospital has changed dramatically. During its first six months of operation, the average inpatient census decreased by 14 per cent, the average turnover rate for all inpatient units increased by 48 per cent, and the total number of outpatient visits also increased by 24 per cent. Before PAU, 13.5 per cent of treatment staff time was devoted to intake evaluation; four per cent of staff time is now so allocated. There is now more time available for patient care, staff, teaching, and supervision.

PAU has not only applied computer technology in order to improve mental health care today, but its success has opened up areas for future work in the field. By using the presently developed and collected data bases, patients could be sub-typed into relevant groups, and standard treatments for each group could be developed. Computerized programs could be "tailor-made" for individual patients to predict their responses to treatment. People in rural areas where no psychiatric help is available could be aided if there was a computerized library with evaluation and treatment reports available to those charged with their care.

Mental health care is no longer in a "pre-technological" state, but relatively few centers today use computers to provide summaries and interpretations of data to their clinical staff. Perhaps the success of PAU, with its proven ability to deal efficiently with increasing case loads, will help change this picture. ■

[For more information, write Dr. Thomas A. Williams, Chief, Psychiatric Service (116), Veterans Administration Hospital, 500 Foothill Blvd., Salt Lake City, Utah 84113.]



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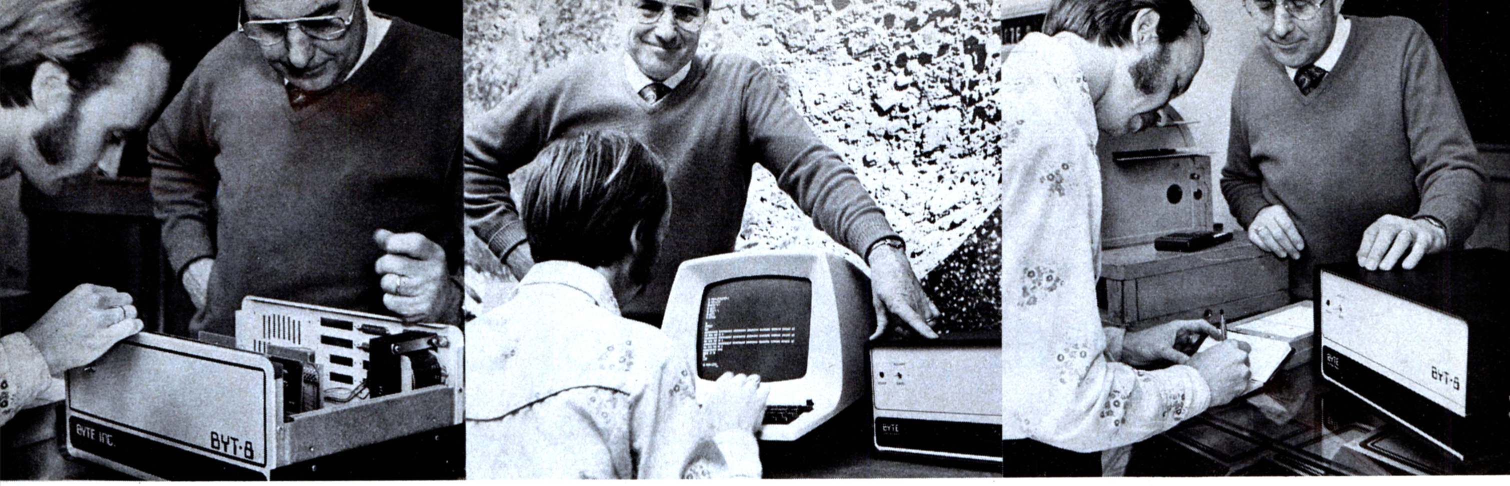

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Heath: Two Computers and Two Peripherals, for Openers

Stephen B. Gray

Heath Company, at last silencing the rumors that have been flitting around for several years, introduced their line of "personal computing products" at a June 1 press party in Benton Harbor. First public showing is scheduled for the Personal Computing Fair in Atlantic City, NJ, August 27-28. Four products are due to be available this Fall:

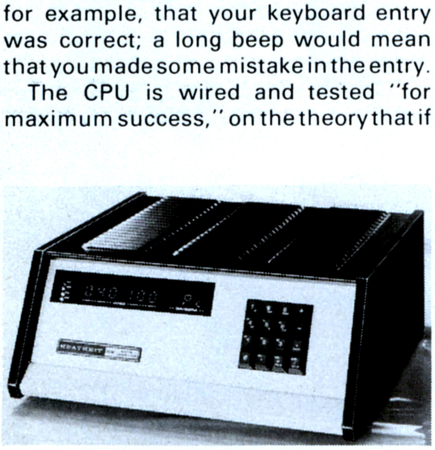
H8 8-Bit Computer

At the lower end of the line is the H8 8-bit computer, using the 8080A MPU. An "intelligent front panel" features a 16-button keyboard for octal data entry, a nine-digit segmented octal display (six for address, three for register or memory contents). and four LED status lights, providing what Heath says is "the most controllable computer on the market."

The bus, which will probably become known as the Heath or S-50 bus, uses 50-pin connectors on a ten-slot motherboard.

A built-in 1K ROM monitor controls the front panel and the load/dump operations, and permits turnkey operation. A built-in programmable speaker provides special effects as well as feedback signals to indicate proper or improper operation: a short beep means, for example, that your keyboard entry was correct; a long beep would mean that you made some mistake in the entry.

The CPU is wired and tested "for maximum success," on the theory that if your CPU board doesn't work, you can't check out anything else. All other H8 boards are in kit form, and all ICs are socketed.



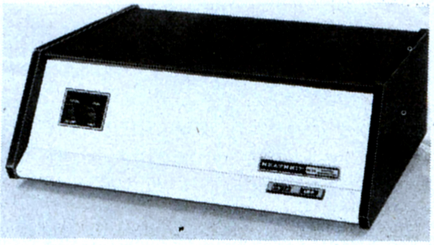
H8 8-bit computer

Mail-order price of the H8 (without memory) is $375, including all systems software on audio cassettes. An 8K memory board with 4K of static RAM is $140, a 4K expansion chip set is $95. The H8 cabinet is configured for 32K of memory; the H8 can address 65K of memory. The serial I/O interface board with 1200-baud audio-cassette interface is $110; a three-port parallel interface is $150. Parallel and serial ports are software-compatible; with the 8251 UART, the software doesn't know if it's talking to a serial or parallel port. All software works with any configuration; no program changes need be made if different peripherals are used. The serial interface uses the Kansas City standard tones and self-clocking for cassette recording, and also has complete modem control.

H8 software includes BH BASIC (Benton Harbor, 8K), Extended BH BASIC (12K), text editor, two-pass assembler, debug, and panel monitor. An interesting feature is command completion: for instance, if you type PR, the computer completes the word by typing INT. Error detection during tape handling is provided. Both BASICs support PEEK/POKE, PIN/OUT, and the SIN, COS and LOG functions are said to be one and a half times faster than in anybody else's BASIC (making for a faster Startrek game). To demonstrate the H8's multitasking capability, one game (Chase) was played on the display, and another (Hangman) on the CRT.

H11 16-Bit Computer

At the top of the line is the H11, using the Digital Equipment Corporation LSI-11 Microcomputer Module. Again, the CPU board is fully wired and tested; all other H11 boards are in kit form, including 4K static RAM at $275, serial interface ($95) and parallel interface ($95). The CPU board will accept a hardware multiply IC, six boards can be plugged into the backplane, and memory is expandable to 20K.



H11 16-bit computer

The H11, at $1295 mail-order for the CPU and 4K RAM, includes a complete DEC system software package, containing editor, PAL-11 assembler, linker, on-line debug package, input/output executive, BASIC (8K) and FOCAL (both 4K and 8K). Purchasers of the H11 will be eligible to join DECUS, the DEC Users Society, "which has a library with over 800 programs designed for the PDP-11 family of computers, many of which were developed for or can run on the LSI-11." The H11 BASIC is said to be 2.5 times faster than any other BASIC (a future development will make it ten times faster), and features strings, PRINT USING, and deletable features.

H9 CRT Terminal

The H9 alphanumeric video terminal has a 12-inch screen, 67-key ASCII keyboard (upper case only), 12-line by 8-character format (with format option of four columns of 12 lines by 20 characters), cursor control, batch transmit, and a plot mode for very simple graphics. Baud rate is selectable, from 110 to 9600; standard serial interfaces include EIA, 20-ma loop, and TTL input/output.

The H9 terminal was demonstrated with the H8 computer, although it can be used with the H11 or any other computer. To load, the user puts a cassette in a cassette player/recorder (Heath will provide a GE unit for $60), presses the LOAD key, and when the program is fully loaded, a short beep is heard. The Timing and Processing board is pre-wired and tested; the rest of the terminal is in kit form, at $503 mail-order.

H10 Paper Tape Reader/Punch

Designed for use with Heath's H8 and H11 computers, the H10 paper-tape reader/punch will work with any other digital computer. The tape is standard one-inch roll or fan-fold eight-level tape, read by the H10 at 50 cps and punched at 10 cps. Independent punch and reader circuits permit simultaneous operation, as in copy mode for tape duplication. Mail-order kit price for the H10 is $350.

H9 CRT terminal

Support

Heath is going all-out to back up their computer products, which represent the largest investment in the company's history. There will be self-instructional programming courses, and a Heath Users Group (HUG) with a newsletter. The group that provides technical help to kit builders over the telephone is gearing up for an expectedly heavy load of calls on the computer products.

A $150,000 training program is aimed at providing at least one technician in each of the 60 Heath centers with the know-how required to service the computer line.

Over ten man-years were spend in writing the various mnuals or the computer line, and over 600 pages of software documentation are in preparation.

The operating manuals will contain step-by-step instructions on what to do with the keyboards and displays, and will show memory maps, I/O port maps, bus designations, etc. The software manuals will contain many examples of program use, and many complete listings, such as the entire floating-point program in BASIC.

H10 paper-tape reader/punch

Other Items

Heath will make the LA36 DEC Write. available although the price hasn't been set yet for this 30-cps teleprinter with 132-column format.

Future plans include floppy disk, more software and interfaces, prototyping cards, graphics, and wired versions of the computer products. —SBG ■

The designer of Processor Technology's computer talks about it in an interview with Dave Ahl.

Felsenstein on SOL

David H. Ahl

Consultant Lee Felsenstein designed the SOL computer's CPU, the Pennywhistle modem, and community memory, and is a charter member of the Hombrew Computer Club. Publisher Dave Ahl interviewed him recently about SOL and other areas.

Ahl: I think you have an idea of our philosophy of the magazine—more toward the end user and applications—and you were mentioning last night that the SOL is at least partially aimed at the OEM market, I guess I'd be more interested, not so much in the hardware design of the machine, but the philosophy of why it turned out the way it did, and who it was aimed at, and what types of applications it's aimed at.

Felsenstein: Well, we can't be very deterministic in this case. Although, as initially designed it was intended as an intelligent terminal with expansion capability, it very rapidly—Processor Technology in the persons of Bob Marsh and Barry Ingram—came up with the fact that it was really intended to be a general kind of building block, but one which could be used even by the end user or micro consumer (not really a good word, as that assumes a computer) in office context and so forth. They wanted to put it all into one box with a keyboard, making it look like a typewriter. They took the measurements of a typewriter during the arguments of how big it should be. And without requiring any massive cabling of units together, as the current boxes with switches and lights all require. It was intended from there on to have a removeable logo which would allow the thing to be sold to an intermediary, an original equipment manufacturer, and then let them relabel it and put their own software in it and perhaps their own hardware—but mostly software—and then they would then offer it to their particular usership.

Ahl: Do you have any OEM customers yet?

Felsenstein: One right now. It's a ham-radio-oriented use. It's not available yet but we've got a picture of it and they've changed the logo. It does things like station logging, and verification, and also they claim that it will do Morse-to-ASCII conversions.

Ahl: That's not quite in the office environment.

Felsenstein: Not quite, but the department that's using it doesn't have to know anything about a computer.

Ahl: Right. Are there any OEMS in the office area or anyone talking about it?

Felsenstein: Well, people call up and they say if you can get me one real fast, then I'm going to put it in an application which will mean hundreds of thousands or, you know...

Ahl: That's usual. We used to get those calls all the time.

Felsenstein: That's happened. But there are no big block customers yet. And they are largely, I think, waiting to see what the little customers can do with these. That's who's buying them now, people who are trying one thing or another, we don't know for what, for some application. Some just want a terminal. Some haven't got it straight about that. They'll eventually figure it out.

Ahl: The SOL was announced in Atlantic City last year?

Felsenstein: Formally, yes.

Ahl: When was the first unit shipped to a customer?

Felsenstein: First shipments occured in December. That was a partial kit. The manufacturing is still being set up. But sometime soon there will be assembled units manufactured and I have heard it said, although this does not have the force of official rumor, that they're ultimately going to give up the kits themselves.

Ahl: What's the assembled unit likely to sell for?

Felsenstein: It will sell for $1,500. It's being offered for that in the Edmonds' catalog. Edmunds' has a great deal of faith. Not more than they ought to have but they're not concerned. They've handled other manufactures who haven't been quite ready yet.

Ahl: Do you have some feeling concerning what people are doing with them so far? You've probably only got a couple months of history. Is it any different than the other computers, or are people buying them for more or less the same reasons?

Felsenstein: It's very hard for me to tell, but I think that there's a definite kind of feeling about it, that people are using these with a bit more intent in mind than with the other hobby computers, because they've been through those already. They've seen them and they're getting SOLs in order to do something. Just what it is we don't know. They're buying the circuit boards and boxing them up as plywood terminals, probably accounting for 20% of them. But what else they're doing we really haven't had any feedback on—at least I haven't heard.

Ahl: It seems to me, at least in the New Jersey Club, and some of the other ones I've been to, that most people are concerned with getting their machine up and running and aren't doing much of anything other than terminal electronics and some fooling around with it.

Felsenstein: Well a number of them in the Homebrew club are writing software because that's what they do anyway and there's a market there that the club provides for them to arise to notoriety. So some of them are basically independent or part-time software houses or writers and they've got the machines to do 8080 software on. There's a certain amount of work going on of writing at various high-level languages. People write software for themselves and for each other. They might expect to sell it. Other than that I really haven't heard of applications. We've always had to call out, "Please tell us what you're using it for." Gordon French asks that at every meeting if he can. Nobody really gets up and responds in public. Maybe that means that all uses are not quite perfected yet, or else everyone is a lot more shy than we thought. So, it's been my analysis and it still is, that people are learning with these things. They're getting the machines up and running and in so doing they have to learn a lot more and I think they're doing it basically out of a sense of feeding out possibilities. Think of the possibilities of a computer, right? Nobody says I can't use it. That's enough to keep a lot of people going. We haven't heard of people dropping out, but of course we probably wouldn't. Dropped out to the point where they get it going and then they realize they haven't got any applications for it. But that's likely.

Ahl: Well, it's like a lot of these doctors who get every disease kit that comes out and they sit around sure that someone will come down with it. Although the investment is fairly substantial, I think most people are going to try to look for applications.

Felsenstein: They're all waiting now for the disk-storage hardware.

Ahl: Is it likely that bubble memories or something in that order will come down in cost through the magnitude of cost of magnetic stores now?

Felsenstein: I personally don't think so, but as an example the charge-coupled device has not come down in price that I know of. Intel can apparently sell enough of them—probably to the labs and so forth who are doing all kinds of gee-whiz video-storage things—so it's not happening as fast as everyone threatened it would happen. At every other meeting someone asks, "Has anyone heard of this or that?" And someone says," Yes, Intel has a charge-coupled device for $55.00," etc. But it doesn't seem as if there's anything in it. It's still a rumor. I read about it in every issue of *Electronics* magazine, or so it seems, but you have to do more than just have a good design for something. You've got to get the whole thing into massive production. You've got to have the orders to justify that and apparently it's a lot more justifiable to do massive or medium-scale production for something that's very expensive than massive production of something that's cheap.

Ahl: Do you think floppies are clearly going to be the key to applications for a lot of people? The mini floppy or the regular floppy, which one's going to gain popularity, or both?

Felsenstein: The mini floppy has a head-start right now. The North Star mini floppy is out and they're shipping a lot of them. I mean, by garage-shop standards, they're shipping a lot of them and they work, which is more than I can say about some other floppy equipment. Each type will have a niche. Applications people will start on mini floppy and will have the capacity for what they really want to do and then I think there will probably be some hard disks for the approximate cost of a dual floppy drive. Many manufacturers of these have just been notified that there's a market out there and they make drives, some of which sell for a thousand dollars with a megabyte or something like that on it. The disk memory is going to be with us for quite a while.

Ahl: You mentioned that you saw the SOL as having a life of perhaps two years in its present form. What do you see as the follow-on product or class of products?

Felsenstein: I think there'll be a proliferation of classes of products. The SOL is the general-purpose kind of a thing and it's going to make a number of manufacturers say "If i didn't need all of that generality I could make something a lot cheaper." And then they're going to find a particular kind of application where they can sell a lot of the units. They're going to have them manufactured using LSI techniques, in effect stamped out of silicon and plastic like calculators are. Now this means, however, that it won't be adaptable, certainly as adaptable as a SOL to other different uses. Well, they won't be worried about that. So there's going to be a number of branches of the tree. I can't name them exactly. There's certainly going to be word-processing—there's already people who are trying to sell mini-computers and disks for that—this will bring it down to a plastic-case word-processing machine that does nothing else, or can't really do anything else because everything is cooked in ROM and soldered in. And it won't have a universal bus connection on it. There will be a lot of accounting and inventory-control stuff. Again, SOL will be used for that initially, but people are going to follow through with dedicated hardware for that purpose and dedicated cooked-in software—firmware, actually. ■

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A New Generation of Biomedical Instruments

John M. Brus

The development of four microprocessor-controlled medical devices at Biomedical Engineering Center for Clinical Instrumentation (BECCI), based at Cambridge, Mass., is pioneering the research trail to a new generation of these devices, according to the consensus opinion of the BECCI research engineers.

Jointly sponsored by the Harvard/MIT Program in Health Sciences and Technology but funded by a National Institutes of Health three-year contract, BECCI's aim is to build a technological resource offering an integrated and modularized set of hardware and software specifically designed for biomedical applications.

To this end, BECCI published last year an upper-level language called STOIC (authored by John Sacks) and developed an "on-line debugging" card, designed by electrical engineer Paul Schulter.

Staff engineer John Volvano explains that "Given the time and effort spent on the background hardware and the STOIC software base...future projects will have little of this work. Engineers need only design one or two hardware cards to interface their particular project and develop the software on STOIC"—considerably telescoping the time needed to transform an instrumentation idea into a prototype.

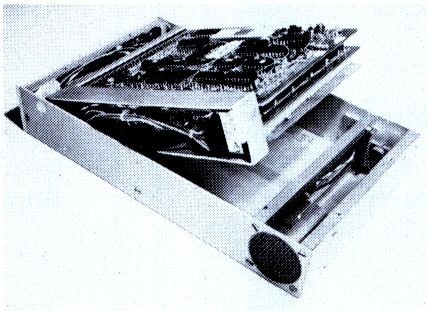
John Sacks, BECCI's software specialist, says STOIC gives the programmer complete control over the execution speed vs. ease-of-programming trade-offs inherent between machine and higher-level languages. Additionally, the debugging card, designed for microprocessors using an Intel 8080, uses a "memory mapping" feature to conveniently "patch" programs as if they were read/write locations, avoiding frequent read-only memory reprogramming.

The purpose of the medical instruments under development is not only to monitor and analyze biological signals but also to present this information in a usable form to the physician. In another sense, however, the research engineers are confronting the question: "How do you program a physician's clinical judgement into a computer?" The best example illustrating some of these difficulties is BECCI's portable arrhythmia monitor, scheduled for limited field-testing this summer.

Monitoring Chaotic Heart Beats

There are almost 700,000 heart-attack victims each year in the United States. Heart attacks usually occur when blood flow to a portion of the heart is reduced or blocked, disturbing the natural rythmic wave of electrical impulses regulating the heart's beating. This leads to ventricular fibrillation—uncoordinated beating of the heart's chambers—and cardiac arrest. People with heart disease are prone to intermittent arrhythmias, and monitoring these patterns provides valuable medical information of the heart's physical situation and response to medication. Since the heart beats about 100,000 times in a 24-hour period, however, a 12 or 24-hour electrocardiogram (ECG) monitor generates mountains of data but only a few of the medically important arrhythmia periods.

BECCI is developing a portable, microprocessor-controlled ECG monitor that recognizes and stores only arrhythmia patterns. In theory, after strapping on the unit in the morning, a patient can go about all his daily activities. At the end of the day, he plugs his monitor into a modem and feeds the data to a hospital computer which will print out hard copy for examination.



The Portable Cardiac Arrhythmia Monitor contains an Intel 8080 processor, 256 8-bit words of read-only memory, 4096 8-bit words of read/write memory, ECG amplifier, 10-bit analog-to-digital converter, bit-serial transmitter-receiver, patient interaction interface, and a DC-to-DC power converter.

The arrhythmia monitor is an ideal illustration of a heretofore impractical biomedical device, according to project engineer Joe Walters, Jr., "This microprocessor technology is clearly opening a new area because there's no minicomputer around capable of being reduced to a box this size (2" x 6" x 10") and this power (3.5 watts)."

However, recognizing arrhythmias is just one of the microprocessor's tasks. A clock enables recording of the time intervals between arrhythmias. Algorithms also classify different types of arrhythmias and compress data for storage.

Although ECG waveforms are easily susceptible to mathematical analysis, Walters admits he hasn't quite yet mastered the trick of converting "clinical judgement" into an acceptable algorithm. Constitutional biological differences between patients illustrates one of the vexing variables. That is, what looks like arrhythmias in one patient may be close to normal in another. compounding that fact with the different possible types of arrythmias means that the arrhythmia algorithm must not only analyze different waveforms, but additionally recognize the arrhythmia as significant in context with the normal heartbeats. Also, extraneous biological impulses feeding into the ECG sensors create problems, such as triggering the monitor to mistakenly store the impulses in memory. One solution, Walters notes, is beefing up the current 4K memory to 16K or even higher. This would allow the use of STOIC and provide the extra capacity to store the extraneous impulses.

Walters also has plans of making the unit interactive with the patient. For instance, after the unite detects an arrhythmia, a buzzer can alert the patient to answer a series of preprogrammed questions presented on a small LCD display. Giving the patient a choice of "Yes," "No" or "I don't know" buttons to push, typical questions might be: "Are you dizzy?" or "Are you having angina pains?" Correlating these answers with the different types of arrhythmias creates more medically useful information.

Computerizing Pulmonary Function Testing

Another unit under development involves a combination whole body plethysmograph (lung volume capacity) and respiratory gas analysis system. Project engineer Niel Dowling says previous plethysmographs, if they've been computerized at all, usually shared time on a minicomputer. "We want to have a processor dedicated to the task to produce a cheaper, more compact system," he explains.

Effective measurement of a pulmonary system includes measuring lung capacity, lung elasticity and CO_2 and O_2 transfer efficiency, as well as how these factors change within the time of an exercise period. Dowling says the microprocessor using analytic equations (e.g., Boyle's Law) can compute lung capacity straightforwardly. Or by comparing two sets of figures (e.g., lung gas ratios and blood gas ratios), the microprocessor derives medically important information on the gas-transfer efficiency of the lungs. Currently, integrated respiratory gas analysis systems and plethysmographs are not mass produced and can cost up to $50,000 counting minicomputer support, according to Dowling. but he believes a dedicated microprocessor system could cut the current cost in half. Field testing of a prototype should begin in Boston's Peter Bent Brigham Hospital this summer.

Measuring Eye Movements To Detect Balance Disorders

Disorders of the inner ear leading to dizziness or loss of balance sometimes are diagnosed indirectly. One procedure, called electronystagmography, positions a patient on a motorized chair that rotates and tilts. Concurrently, eye movements are monitored and analyzed, since inner ear balance disorders reveal themselves in eye velocities by an integrated response called the ocular-vestibular reflex.

Project engineer John Tole says electrodes placed at the eye corners can measure differences in electrical potential caused by eye movement. Again, these eye movements are susceptible to the type of mathematical analysis microprocessors happily perform. But, just as with the ECG monitor, Tole explains that patients with abnormal characteristics (e.g., unusual head thickness or weaker neurological responses caused by extreme age) can test the flexibility of the software. So far, the algorithms are standardized for a typical middle-age patient with normal neurological response. Additionally, the microprocessor sequences all chair movements and records the chair and eye movements on a time scale because some of the reflexes seem to have a delayed reaction effect.

Measuring Blood Flow

Developing a thermal probe that directly measures blood flow in living tissues is BECCI's fourth project. By placing an electrically heated needle-like probe within the tissue or organ, sensitive measurements of the rate at which the tissue absorbs heat from the probe are made. Comparing these "heat-sink" values, in the presence of blood flow, with standardized values of tissue conduction, in the absence of flow, leads to calculations of the blood flow which carries heat away from the probe.

Project engineer John Volvano says the instrument is due for field testing this summer at the Walter Reed Army Institute of Research near Washington D.C. Aside from an easily correctable but unforseen problem of shielding the sensitive electronic components, Volvano believes the software and hardware is near perfection.

Dr. H. Frederick Bowman, director of BECCI's thermal probe project, says the probe has a number of potential uses. One may be the post-operative monitoring of surgical patients and another the monitoring of transplanted organs to assess disorders steming from restricted blood flow. Knowledge of low flow rates (known as "shock") are important in patient care.

Bowman also explained that changing the instrument's software enables the probe to monitor the concentration of other fluids. This can be important in the emerging field of cryopreservation—where donor organs are stored for future transplantation. Using a cryopreservative "biological antifreeze" to prevent tissue destruction, the probe could monitor the freezing and thawing rates and "antifreeze" concentration levels for each organ system—all of which have to be meticulously recorded to discover the optimum rate.

Cheaper but powerful computer components are obviously finding a home in biomedical instrumentation. And with a little imagination, the hand-held "body-function analyzer" used by *Star Trek's* Dr. McCoy may not seem to be so impossible after all. ■

The Miraculous Medical Microprocessor: A Look Into the Future

Pamela Weintraub

Can a mild-mannered scientist travel to Mars and back, cleverly avoiding the notorious space sickness that knocks out half of our brawny astronauts? Can a 50-year-old veteran who's lost a leg in the war run the hundred-yeard dash and win? And can dying cancer patients go into deep-freeze, confident that they'll thaw out centuries later to receive the cure? Well, not yet. But if medical microprocessors live up to expectation, they may change these unrealistic scenes into everyday fact.

From electrocardiograms with whistles and bells, to zero-gravity flight-simulators, almost any instrument can

Prof. Roger Mark (right), director of BECCI, and project engineer Joe Walters, Jr. stand next to their heartbeat monitor.

be plugged into microprocessor systems. And since BECCI engineers design microprocessors with interchangeable parts, they can asemble almost 90 percent of the hardware for any given instrument from off-the-shelf parts. Thus, as the four current BECCI projects near completion, scientists are faced with the arduous task of deciding what device they'd like to work onnext.

"We want to provide the medical community with resources to build microprocessor-based instruments," says Prof. Roger Mark, BECCI's director. "If hospitals need a special-purpose microprocessor, they can come here and we'll have the necessary hardware, software and staff to build the device."

The Computerized Body

Prof. Mark speculates that portable, battery-operated processors—such as his heartbeat monitor—will result in vastly improved artificial limbs. Scientists might develop a mechanical knee that operates as smoothly and quickly as the real thing.

Our limbs move in response to electric signals coming from the central nervous sytem and brain, Dr. Mark explains. Such signals travel through the body even if corresponding limbs are no longer intact. Thus, if surgeons attach nerve endings directly to microprocessor terminals within an artificial knee, the computer will read the body's signals and instruct the mechanical part to move just as the real knee would have.

Lightweight processors may also bring sound to the deaf.

"It turns out that the hearing aids we now have are just amplifiers," says Prof. Mark. "And just amplifying sound is worthless when you're trying to make totally deaf people hear; such people are deaf because they've lost the ability to pick up certain frequencies. So, if you amplify everything you'll turn an unintelligible squeek into an unintelligible roar. But computerized hearing aids could translate normal speech into frequencies easily understood by the deaf."

Indeed, microprocessors that improve upon the human ear may one day sharpen our other senses as well. And like the mythical Martian, we'll hook up to computerized antennae that cue us in on coming earthquakes, winning horses and the next day's weather.

Human Storage: The Deep-Freeze

While Dr. Mark feels that microprocessors will build our bodies into stronger, more durable shells, Prof. H. Frederick Bowman predicts that these computers will also unravel some anatomical mystries within. In fact, Dr. Bowman's thermal-probe project uses processors to gather information that might help scientists freeze an entire person for hundreds of years.

Fred Bowman became fascinated, early in his career, with the problem of removing heat from living material. He realized that if scientists could freeze human organs, they could also establish a biological storehouse to provide the ill with healthy kidneys, livers, hearts and lungs. The key to this wealth of human parts lay in "biological anti-freeze"—a substance almost impossible to produce without help from a microprocessor.

"Each cell will survive the freezing/thawing process provided that it's frozen and thawed within a given time-span," Prof. Bowman explains. "If it's frozen faster or slower than that the cell will die." And since organs are made up of many different cell types, freezing a heart or lung has always been virtually impossible.

"You would have had to take the organ apart, freeze it cell by cell and put it back together again," comments Prof. Bowman. "Then you'd be playing God."

But now, with microprocessors to analyze the freezing/thawing process of each cell type, scientists may soon produce a major substance to broaden the overall time-span. The biological anti-freeze could provide us with a time machine more potent than anything imagined by Jules Verne. And a society where modern-day explorers travel icily into the future looms amazingly close.

Space Bound

Mark and Bowman contemplate the promise of lightweight computers here on earth, but another BECCI scientist works toward the day when he'll use processors to aid his experiments in outer space. If Prof. Lawrence Young succeeds, he may be the first researcher to feel more comfortable in a space capsule than a Cadillac.

Rapidly spinning chairs, slick model airplanes and kaleidoscopic patterns create the carnival-like atmosphere of Dr. Young's balance-testing lab. From this unusual arena, the innovative Professor of astronautics uses processors to study motion-sickness on earth.

Earth or space style, motion-sickness results most frequently under just such abnormal, man-made conditions. And whether plagued individuals spin violently in Prof. Young's laboratory chair or travel through the Milky Way at thousands of miles per hour, the symptoms include nausea, vomiting, dizziness and appetite-loss.

Thus, while patients coming to this unie terra-firma workshop jolt back and forth in flight-simulators or stare at whirling designs, Prof. Young thinks ahead to the day when scientists—and even ordinary tourists—will travel through space without experiencing unpleasant zero-gravity side-effects.

To this end he's planning a series of experiments for the 1980 Spacelab flight. In one test, astronauts ride the "space-sled"—an accelerating platform within the space ship—as scientists use electrodes to measure the rapid, involuntary eyeball oscillation associated with motion-sickness; results will be analysed via the microprocessor.

Young's work could improve the quality of outer-space living for geerations to come, with flights smooth enough to accomodate even the queasiest researcher or tourist. Passengers will learn to perform exercises that prepare them for the rigors of universal travel, and to avoid situations that produce the dreaded space disease. And since awkward design contributes to space sickness, Young's results might even create a demand for interior decorators specializing in extra-terrestrial dwellings.

And as a bonus for those who plan to stay on earth, the experiments could yield powerful cures for carsickness, seasickness and airsickness.

"The motivation for using microprocessors in the project is that they're small, cheap and powerful," says Prof. Chalres Oman, who's worked on several projects with Dr. Young. "They allow us to put a great deal of computing power into a small area—like a bedside, a clinic or a space capsule."

The microprocessor developed for clinical use is so convenient, says Dr. Oman, that scientists have even considered taking it over to the Johnson Space Center and plugging the data that comes down from orbit right into it. ■

Prof. Lawrence Young, director of BECCI's balance project. He'd like to make space flight fun for everybody.

Two Space Games (With Graphics!) For Your Home Computer

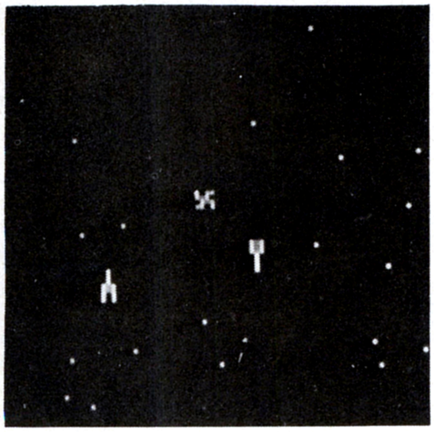
Steve North

Do you own a Cromemco TV Dazzler or a Processor Technology VDM-1? If not, and if you're a fancier of space games, you might want to get one (or both)! Space games for personal computers with graphics have arrived, in the form of Cromemco's SPACEWAR and Processor Tech's TREK 80. These games offer you sophistication you won't find in any coin operated machines.

SPACEWAR

Of the two games, SPACEWAR provides more impressive graphics—because the TV Dazzler was designed with graphics in mind, while the VDM-1 does a better job of displaying characters. SPACEWAR is modeled closely on the old Spacewar game which has been around for years. It's played on a TV screen which represents the galaxy. However the galaxy isn't planar. If you drift off one side of the screen, you reappear on the other side, so actually the galaxy is a sphere. The four corners of the screen represent the same point, the point furthest from the center. The objects in the galaxy are the spaceships, torpedoes, stars, and the sun.

Within this portion of space, the two combatant's spaceships travel around a central sun and are attracted to it by gravity. The spaceships are controlled by Cromemco JS-1 joystick consoles. Push the stick forward, and your ship accelerates. Push the joystick to the right or left and your ship rotates clockwise or counterclockwise. Push button one on the joystick console, and a torpedo is fired from the nose of your ship in a direction relative to that of the vessel. The object of the game is to blow up your opponent's ship with a torpedo, while your ship remains intact. You have 32 torpedos and 30 seconds worth of fuel. Torpedos self-destruct after a short period. Their range is thus limited by their speed. If button 1 is held down, torpedoes will be fired in a machine-gun-like fashion at the rate of 2 per second. Pull the stick all the way back, and you enter hyperspace. After a few seconds your vessel pops out of hyperspace in a random location, but disguised as a star. After a few more seconds, the star turns back into your vessel, with a random course and speed. So what's to prevent you from hyperspacing continuously? First, a timer prevents you from re-entering hyperspace immediately after exiting. Second, when you exit hypespace, there is a 1/8 chance of blowing up. Third, while your ship is a star it is vulnerable to attack. Hyperspace is best used only as a last resort to escape an opponent's torpedo which can't be shot down.



SPACEWAR display, with whirling swastika-like sun at center, toward which spaceships are attracted by gravity.

As mentioned before, there is some additional scenery in this game. The slowly rotating star field basically functions as background, probably to hide ships when they pop out of hyperspace. The sun, at the center of the screen, has a gravitational effect which can make for some interesting maneuvers. If your ship falls in, it gets split up into all four corners of the screen (which isn't fatal, since they represent the same point). By setting console switches at the start of play, you can eliminate the starfield, eliminate the sun, or make the sun lethal, which means that if you fall in, you lose! (This is preferred for "serious" play.)

TREK 80

TREK 80, as all you superbrains will have guessed, is based on Star Trek. Actually TREK 80 has borrowings from both the standard matrix-oriented Star Trek game (such as Super Star Trek) and TREK 73, a rather sophisticated pseudo-realtime Star Trek in HP 2000 BASIC (no, don't write for copies, please).

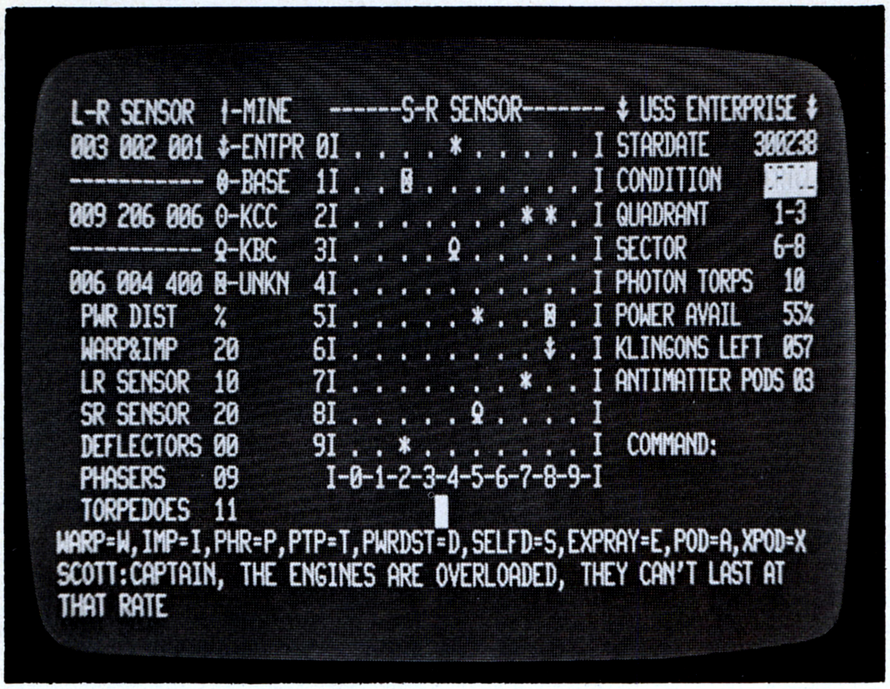
TREK 80 is a real-time game, as opposed to most Star Treks in BASIC which let you enter a command, execute it, stop all the action and get another command, etc. In TREK 80 things are happening while you type in commands. It's played in 10-by-10 galaxy sectors, with the following objects: the Enterprise (you), Klingons, space mines (which explode when disturbed), starbases, and unknown objects. All the data needed for playing TREK 80 is displayed on the VDM constantly. The short-range scan is placed at the center of the screen, with the long-range scan in the upper left, status report in the upper right, and miscellaneous messages displayed in the extreme bottom section of the screen. Also on the screen are a key to the short-range scan, a list of commands, and a place for you to type in commands. All these displays are updated constantly, so that as you're warping through quadrants, you see them on your short-range scan and the adjacent quadrants on the long-range scan. Here's a brief rundown on the TREK 80 commands:

Warp engines: As in regular Star Trek, they are used to move you from quadrant to quadrant. But in TREK 80 you merely specify the course, not warp factor. The ship then moves at a constant speed in the designated direction, and stops when you enter a new command.

Impulse engines: Basically the same as warp engines, except that they move you only within your present quadrant and shut down upon entry into an adjacent quadrant.

Phasers: You enter the direction of phaser fire and then they zap whatever is in the way.

Torpedos: Same as phasers except



```
L-R SENSOR  ↑-MINE     ------S-R SENSOR------- ‡ USS ENTERPRISE ‡
003 002 001 ‡-ENTPR 0I . . . . * . . . . . I STARDATE    300238
----------- Ø-BASE  1I . . Ø . . . . . . . I CONDITION   [illegible]
009 206 006 Θ-KCC   2I . . . . . . . * * . I QUADRANT      1-3
----------- Ω-KBC   3I . . . . Ω . . . . . I SECTOR        6-8
006 004 400 ⊠-UNKN  4I . . . . . . . . . . I PHOTON TORPS   10
 PWR DIST   %       5I . . . . . * . . ⊠ . I POWER AVAIL   55%
 WARP&IMP   20      6I . . . . . . . . ‡ . I KLINGONS LEFT 057
 LR SENSOR  10      7I . . . . . . . * . . I ANTIMATTER PODS 03
 SR SENSOR  20      8I . . . . . Ω . . . . I
 DEFLECTORS 00      9I . . * . . . . . . . I  COMMAND:
 PHASERS    09        I-0-1-2-3-4-5-6-7-8-9-I
 TORPEDOES  11                 █
WARP=W,IMP=I,PHR=P,PTP=T,PWRDST=D,SELFD=S,EXPRAY=E,POD=A,XPOD=X
SCOTT:CAPTAIN, THE ENGINES ARE OVERLOADED, THEY CAN'T LAST AT
THAT RATE
```

TREK 80 display, with short-range scan at center

more powerful.

Energy distribution: You are permited to alter the percentage of energy allocated to any of the devices on the ship. Our use of this command has not been entirely successful because the ship blows up almost every time we use it.

Experimental ray: A very interesting feature, because you never know what the experimental ray is going to do. It can make the Klingons invisible, destroy all the ones in your quadrant, freeze time for the Klingons, jumble the quadrant, or disturb the space in your quadrant. It can also cause a "computer malfunction," which means it puts the system in an infinite loop!

Pods: There are two commands for control of antimatter pods, A and X. They seem to refer to launching pods and exploding them respectively.

A Brief (Yet Useless?) Comparison

Why do we say useless? Because who in their right mind is going to buy $200 to $500 worth of hardware to play a $15 game? But as long as we're beating this thing to death....

Obviously SPACEWAR is the more visually striking game of the two. However it does predicate that you have more of an investment in hardware then TREK 80 (a TV Dazzler, A/D, and two joystick consoles, vs. a VDM-1). Although the rules for SPACEWAR seem simpler than those of TREK 80, it is a bit difficult to master the controls, since what you control is your acceleration, not velocity or position. Of course, that's probably more realistic, and certainly more challenging. Because of the graphic capabilities of SPACEWAR, you can try out some interesting tactics—like sending torpedoes off one end of the screen, so they will appear from nowhere on the other side; or using the sun for a slingshot effect to save fuel. TREK 80 is a much more complex game (from the user's viewpoint—offhand, the idea of programming SPACEWAR in machine code seems a little overwhelming).

It might be helpful at this point to note that our experience with playing TREK 80 was a little, uh, unique. We tried it out on a newly acquired Sol System, courtesy of Processor Technology. Unfortunately the Sol temporarily had the wrong character generator ROM in its VDM. The symbolic character generator displays control characters as special freaky symbols such as backwards question marks, check marks, little lightning-bolt-shaped characters, etc. These symbols are used by TREK 80 to represent the objects in the short-range scan. Our VDM displayed the control characters as infinitesimally small two-letter abbreviations, so it was almost impossible to tell who was what on the short-range scans. We also did not have the instructions to TREK 80, because as of this writing they don't exist (though Processor Tech will give you the instructions when you buy the game). Consequently our style of play was rather strange. While I would have preferred a more rational, conservative approach, Dave Ahl seemed bent on blowing up as many objects as possible without regard for what they were. (We got the correct character generator a few days later and it enhanced play considerably.)

If you're the kind of person who is easily bored by games like Pong, you may find the same to be true of SPACEWAR after a while (although we doubt it). Of course not everyone likes Star Trek games either, so you'll have to decide for yourself. One feature of TREK 80 we liked was that, at the start of the game, you are permitted to set the speed of the simulation. SPACEWAR is always played at the same speed—quite possibly because it is a very complex simulation and the system may be computing at full speed. SPACEWAR has to move all the objects in the galaxy around at the same time, and check to see if any are getting too close, since torpedoes can detonate each other. (This type of problem is also found in TREK 73, the simulation-type Star Trek game mentioned before, which really bogs down when many objects have to be moved around.) At maximum speed in SPACEWAR, your vessel can cross the screen in about one second. However this can only be done by first constant burning in one direction for thirty seconds. The controls do seem a little sluggish, which may also contribute to the difficulty in learning to operate them. This criticism of SPACEWAR should not be interpreted to mean that it's not a fantastic game, though! After a few hundred hours we can vouch to it's addictive effect. Besides, microcomputers are not noted for their high computing speed. One thing about TREK 80—all the courses are in integers, 0 to 7. Is that bad? Maybe not. It's almost quicker to just move up a sector or two, than it is to try to figure, "Is that going to be a 5.6 or a 5.7?" TREK 80 apparently already uses all the graphical capabilities of the VDM, while SPACEWAR is a black-and-white game which could be more exciting if color were used. Imagine, one ship green, the other blue, yellow sun and exhaust, white stars, red torpedoes, big colorful explosions when someone gets hit! The truth is that though you can think of improvements for almost any game, these games are fascinating as they are now—our hats are off to the people who programmed them, *in assembly language!* And, not to show any kind of partiality, if any of the manufacturers of other video devices (such as Merlin, etc.) have any interesting graphic games, we'd be happy to try them out.

Sources

SPACEWAR is available on paper tape with complete documentation for $15.00 from Cromemco, 2432 Charleston Road, Mountain View, CA 94043. (415) 964-7400.

TREK 80 is available on cassette tape for $9.50, or on paper tape for $14.50; both with complete documentation, from Processor Technology Corp., 6200 Hollis Street, Emeryville, CA 94608. (415) 652-8080. ■

Computerized Robots: A Step Into The Future for Hospitals

Susan Trout Armstrong

A Wichita, Kansas, hospital has overcome some of its logistics problem through the use of computerized "robots."

Visitors to St. Joseph Medical Center may be surprised to see the efficient, automated carts toting linens down a corridor toward the laundry room—through tunnels and up elevators—without a driver or any visible means of propulsion.

Amscars, with modules loaded with laundry, travel the 325-foot tunnel that connects east and west campuses of St. Joseph Medical Center, Wichita, KS.

The helpful robots are called Amscars, and they are designed to handle a variety of hospital chores, stopping short of actual patient care. In fact, the electronically-guided vehicles transport tons of food, linens, ward supplies, pharmaceuticals and trash throughout the health-care complex.

Faced with a wide-spread hospital facility and ever-increasing costs, St. Joseph Medical Center turned to automation for help. The Amscars were developed by Amsco Systems Company, Erie, PA, as one answer to the serious problem of rising hospital costs. The St. Joseph Amscar system was the first in a Kansas hospital, and the 16th installation in a U.S. hospital.

For St. Joseph Medical Center, the robots were a welcomed step into the space-age. The sprawling complex is full of ramps and walkways that consume employee time and energy. At last the hospital could eliminate some of the non-productive time spent by personnel travelling up and down long hallways.

"Hospitals cannot automate patient care, so we are using automation where patient care is not involved," explains Mother Mary Anne, executive director of the facility.

The robots are actually a "material distribution" system, with the guide-paths in service corridors, instead of public corridors. "Because many materials must be kept sterile, they cannot be subjected to the environment of public corridors," one hospital official said. "Conversely, public corridors should not be subjected to contaminated material."

The innovative system uses Amscars to serve both the medical center's west campus and the east campus. The buildings of the two compuses are connected by a 325-foot concrete underground tunnel. The system uses clean recovery areas and soiled sending areas to prevent cross-contamination at the user levels.

Amsco Systems Company explains that the driverless carts follow a predetermined electronic guidepath which consists of special wiring embedded in the floor slabs of service corridors and covered with normal non-conductive floor-covering materials. Wires are arranged throughout the complex in continuous-loop circuits, and are energized by 6.5-KHz and 10-KHz oscillators so they radiate a magnetic field over a very short distance.

Amscar units have special coils to sense the magnetic field along the guidepath. The magnetic field is amplified to control the Amscar's steering mechanism, and the circuitry holds the robot to within a fraction of an inch of guidepath.

Transmitters, receivers, electric eyes and other devices enable the Amscars to stop and wait their turn at intersections, open and close automatic security doors, and enter and leave vertical lifts (elevators) at the correct floors, all automatically.

The robots carry various enclosed containers called "modules" throughout the medical center on pre-selected routes. For example, one Amsacar may transport a locked module full of pharmaceuticals from the supply area to the patient ward. Another Amscar might carry an insulated food module—designed to keep meals hot—from the kitchen to the nurse's station.

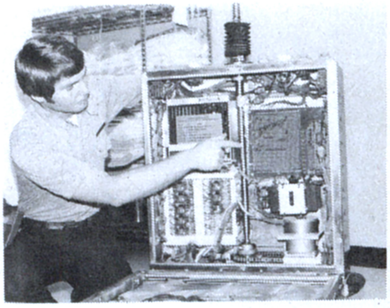
At St. Joseph Medical Center, the Amscars operate on a 16-hour-per-day schedule. Staff members at the dispatch station load the cars and automatically send them on their way. At the receiving end, other personnel unload the robots and press a start button to return the unit to its proper station.

At the Control Station, a dispatcher can monitor the Amscar lifts. Essentially, he uses a desk-type unit with an indicating panel (one for each Amscar lift) mounted to its top surface. The panel contains lights which indicates:

1. Location of the lift (floor).
2. Status of the lift (vacant or containing an Amscar).
3. Amscar at lift entrance position (at each floor).
4. Amscar at lift exit position (at each floor).

Other lights on the panel indicate possible malfunctions, such as "door obstructed."

Safety devices are included within the robots, too. They are responsible for halting the cars when they come into contact with people or other obstructions. The units travel at one mile an hour during automatic operation, but the motor provides for dynamic braking as well as for propelling the vehicle. One Amscar safety feature is the pneumatic bumper assembly. Air pressure created by bumper impact activates the bumper switch, and the car stops automatically. Still, employees say they steer clear of the vehicles as the Amscars go about their work, steadily travelling the halls with hot trays of food or dirty dishes, clean or soiled linens, or other hospital supplies. ■



The manager of the Amscar System at the Medical Center shows the complicated circuitry within the Amscar itself.

BASIC and the Personal Computer

Thomas A. Dwyer

A quiet but important development in the history of computing took place in the mid-sixties at Dartmouth. It was there that John Kemeny and Tom Kurtz developed a philosophy of computing based on a concept Kemeny has since called "the new symbiosis." The idea was to make it easy for people and computers to interact. The system that resulted has made it amazingly simple for thousands of "ordinary" people to both access (through time-sharing) and use (because of the language BASIC) the power of computing in a variety of new ways.

Prior to the introduction of BASIC and time-sharing, the use of computers was influenced by rather specialized interests. In addition, computer applications were restricted by languages and operating systems geared more to the requirements of machines than people. Getting relatively simple algorithms implemented was quite a hassle. But today high-school kids regularly do things with computers that even the professionals on research projects didn't contemplate a dozen years ago.

If the transition from computer access by a few, to imaginative use by thousands of college and high-school students has produced this kind of openness, imagine what we're in for by 1980 now that the cost-barrier has been broken on personal computers. Whole new cultures and outlooks will start to influence the course of computing. This will be a more important factor in resolving Weizenbaum's "Computer Power vs. Human Reason" dilemma than all the computer literacy courses laid end to end. It's this working with computers by many people that will best reveal both their "convivial" and their "manipulative" potentials.

Despite much interesting academic work on other computer languages, the best bet for making personal computers accessible is still BASIC, but in a modern expanded implementation such as BASIC-PLUS (Digital Equipment Corp.), or Altair EXTENDED BASIC (MITS). While the development of other new languages is important, the fact remains that a new idea doesn't become a really good idea until it's communicated, made available, and proven in use. It's in these areas that extended BASIC is currently king.

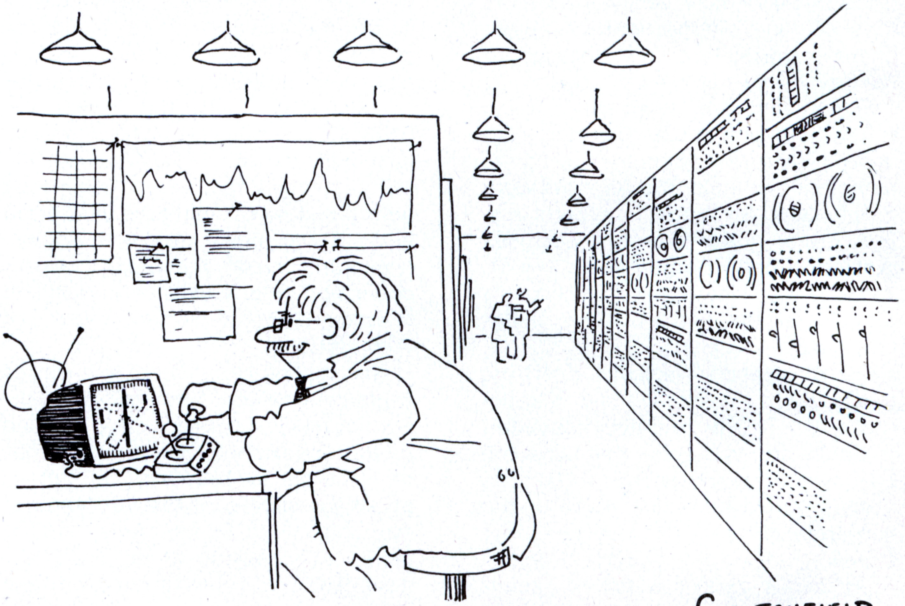
There are also some fallacies about BASIC that need to be dispelled.

1. *"It's not a powerful language."* That may be true of BASIC, but not of a good extended BASIC. For example, did you know that BASIC-PLUS allows both recursive functions and recursive subroutines? And things like the (IF...THEN...ELSE...: GO SUB) structure, string functions, and dynamic string arrays make the other widely-used language FORTRAN look clumsy by comparison.

2. *"It's a language meant for timesharing."* Look at the title of this series, and then look at the ads in this journal, and you'll see how false that is. What should be said is that it's a language meant for interactive computing, which makes it a natural for personal computing.

3. *"BASIC is inefficient."* There are two misunderstandings here. At the technical level, this statement about BASIC is really referring to implementations of the language. There is no reason that there cannot be implementations which produce efficient "object code" for run-time use once the interactive development session has been finished (in fact there are). But the real issue is "total efficiency," including the time of the programmer, and that's where an interactive language like BASIC excels.

Debate about these issues will continue of course, and that's a healthy thing. And someday there may be



CRITCHFIELD

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readily-available super languages. In the meantime, "enjoy."

This is a series that will help you do that by getting started with the fundamentals of BASIC. The series is derived from Chapter 2 of a new book called "An Amateur's Guide to Personal Computing" (to be published by Addison Wesley Co., Reading, Mass., 01867). Chapter 2 is entitled "The 8-Hour Wonder: All About Basic Programming in One Long Day (or Eight Short Nights)." It covers the most important features of the proposed new ANSI standard BASIC, and shows how these relate to BASIC-PLUS and Altair EXTENDED BASIC.

Later chapters discuss strings, arrays, files, and other extensions, as well as a variety of applications in areas as diverse as sports and recreation, word processing, games, dynamics, graphics, art, simulations, and data processing. As you'll see, it all builds very rapidly, and "high-level" ideas on how to use your micro will come a lot faster when you start using a "high-level" language like extended BASIC.

THE 8-HOUR WONDER

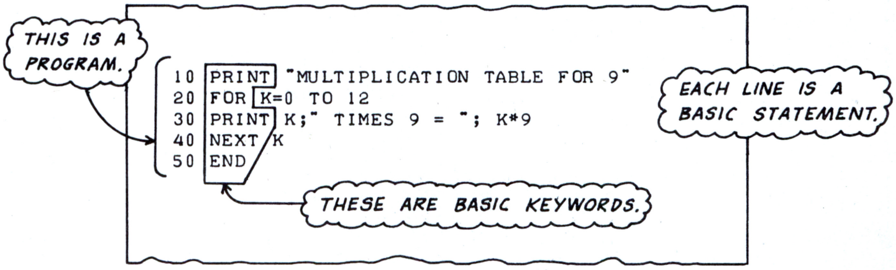
All About BASIC Programming in One Long Day (or Eight Short Nights)

2.0 Introduction

Developing an artistic command of BASIC and Extended BASIC—which is really where we're headed—will take a while. But getting the fundamentals under control takes very little time—even less than eight hours for most people. This is because the language has a small vocabulary, and the words used pretty well mean what you'd expect.

In this chapter we'll look at about twenty *key words* from this vocabulary. Another dozen or so key words will be explained in Chapters 3 and 4. These, together with a numbr of programming *techniques*, will enable you to express ideas with a growing fluency. Add the sage old advice of "practice, practice, practice," and you'll be a virtuoso of the ASCII keyboard in no time at all.

The key words of BASIC are used to make up what are called *statements* (which are something like "sentences" in the language). Statements are then put together to form *programs.* Here's a simple illustration of how this works for the example shown earlier in Chapter 1.



```
10 PRINT "MULTIPLICATION TABLE FOR 9"
20 FOR K=0 TO 12
30 PRINT K;" TIMES 9 = "; K*9
40 NEXT K
50 END
```

Each statement is an instruction to the computer. You'll notice that statements begin with what is called a *line number* (ln for short). This can be any integer from 1 to 3200 that *you* choose. The computer then uses the order of these numbers to determine the order in which to execute (carry out) the instructions in your statements.

Most people use line numbers 10, 20, 30, etc. to leave room for instructions they may have forgotten. For example, if you add a statement 35 at the bottom of a program like this:

```
•
•
30 PRINT K
40 NEXT K
50 END
35 PRINT "***********************"
```

the computer will know you want to print a line of asterisks after line 30. When you LIST this program, you'll find that statement 35 has been inserted between statements 30 and 40 (a very nice feature!).

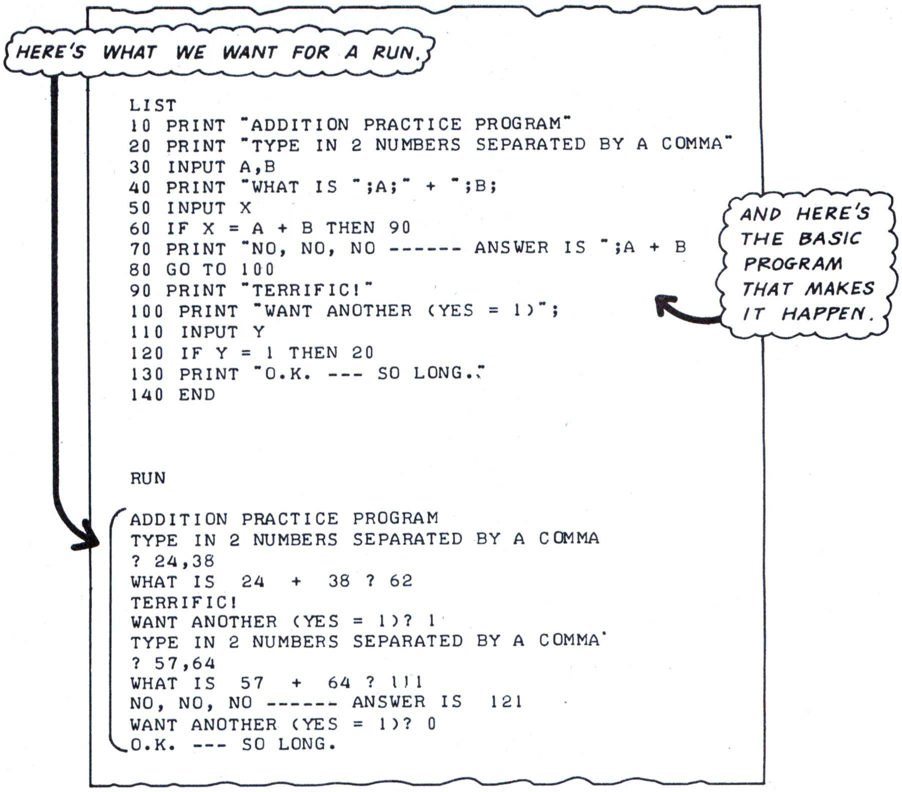
2.1 HOUR 1*: USING A COMPUTER TO HELP JUNIOR PASS MATH 101

Let's start out by showing how to write a useful program with only six key words (in the case of IF...THEN we should strictly talk about a key-word "pair"). Our application will be an automated "math practice" program that can be both a fun game to play and a painless way to get proficient at arithmetic.

To understand this program, we suggest you first look at what it does when it is executed (RUN). This is a good approach to most programming. It's better to first think about what you want to happen, and *then* write the program (set of instructions) to do it.

---

* Hour 1 is the longest since it has a lot of detail. It's probably best to go through it lightly the first time, and re-read it more carefully later.


HERE'S WHAT WE WANT FOR A RUN.
AND HERE'S THE BASIC PROGRAM THAT MAKES IT HAPPEN.

```
LIST
10 PRINT "ADDITION PRACTICE PROGRAM"
20 PRINT "TYPE IN 2 NUMBERS SEPARATED BY A COMMA"
30 INPUT A,B
40 PRINT "WHAT IS ";A;" + ";B;
50 INPUT X
60 IF X = A + B THEN 90
70 PRINT "NO, NO, NO ------ ANSWER IS ";A + B
80 GO TO 100
90 PRINT "TERRIFIC!"
100 PRINT "WANT ANOTHER (YES = 1)";
110 INPUT Y
120 IF Y = 1 THEN 20
130 PRINT "O.K. --- SO LONG."
140 END


RUN

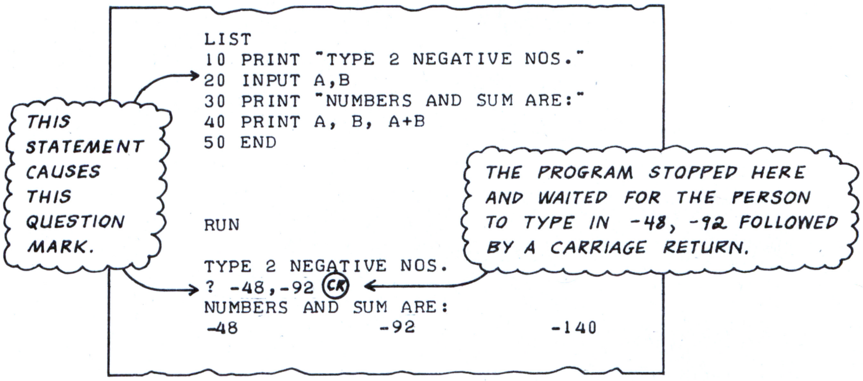
ADDITION PRACTICE PROGRAM
TYPE IN 2 NUMBERS SEPARATED BY A COMMA
? 24,38
WHAT IS  24  +  38 ? 62
TERRIFIC!
WANT ANOTHER (YES = 1)? 1
TYPE IN 2 NUMBERS SEPARATED BY A COMMA
? 57,64
WHAT IS  57  +  64 ? 111
NO, NO, NO ------ ANSWER IS  121
WANT ANOTHER (YES = 1)? 0
O.K. --- SO LONG.
```

Before looking at the logical "flow" of this program, we'll first explain each of the key words used. The keyword PRINT is partly obvious. It will be explained in full shortly, but this will be easier if we start by showing what the INPUT statement does.

INPUT

In lines 30, 50, and 110 the keyword used is INPUT. Let's see how this works. The idea of the INPUT statement is to make a program stop when it reaches that line, print a ?, and wait for the person running the program to type in (input) some "data." Data can be either numbers, or (as we'll explain later in Chapter 4), characters, or even "words." But for now they must be numbers, either integers (like 5,89,-13) or decimal numbers (like 3.1416 or -.00328). *Fractions may not be used.* To input a number like 1/3, type .333333 instead.

INPUT is always followed by one or more *variable names* (separated by commas if there are two or more variable names). In our example, the variable names we have chosen in line 30 are A and B. To see what INPUT does let's look at a simpler program first:

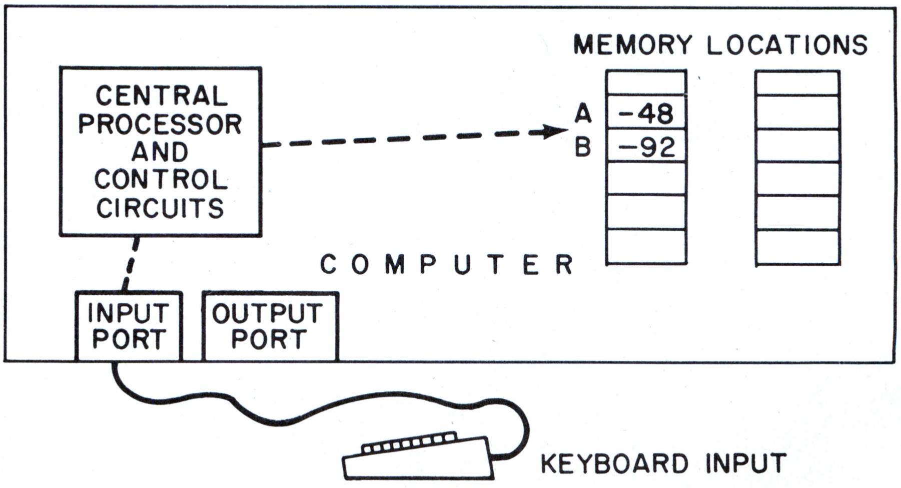

THIS STATEMENT CAUSES THIS QUESTION MARK.
THE PROGRAM STOPPED HERE AND WAITED FOR THE PERSON TO TYPE IN -48, -92 FOLLOWED BY A CARRIAGE RETURN.
CR

```
LIST
10 PRINT "TYPE 2 NEGATIVE NOS."
20 INPUT A,B
30 PRINT "NUMBERS AND SUM ARE:"
40 PRINT A, B, A+B
50 END

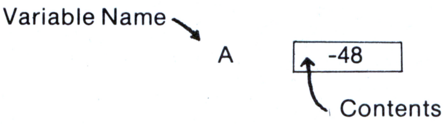

RUN

TYPE 2 NEGATIVE NOS.
? -48,-92
NUMBERS AND SUM ARE:
-48           -92           -140
```

What happens inside the computer after the carriage-return key is pushed is that the two memory locations called A and B are set up, and the numbers -48 and -92 are stored in these locations. The situation looks something like the following:


MEMORY LOCATIONS
CENTRAL PROCESSOR AND CONTROL CIRCUITS
A
-48
B
-92
COMPUTER
INPUT PORT
OUTPUT PORT
KEYBOARD INPUT

Notice that the *name* of a memory location is different from the *contents* of that location. The name is often called a *variable name* (or simply a *variable*) because the contents can be changed (varied) by a program. Thus for each memory location, we can envision a picture like this:


Variable Name
A
-48
Contents

PRINT

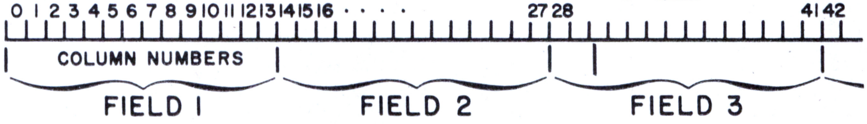
If a program statement says: 5 PRINT "A" it means print (or display on a screen) the letter "A". If a program statement says: 25 PRINT A it *doesn't* mean print the letter A, but rather to print the *contents* of memory location A (which is -48 in our simple example).

If a program says:

40 PRINT A,B,A+B

it means PRINT the *contents* of location, A, the *contents* of location B, and the *sum* of the contents in locations A and B. The *commas* in the PRINT statement mean that the contents (numbers, in our example) should be printed with enough space between them to make the numbers fall into *fields* that are 14 spaces wide. The fields in your BASIC may not be 14 units wide. Find out by running this program and counting what you get.) A space is allowed for the sign in front of the number, but "+" prints as a blank space. We used negative numbers so you could see the sign. Notice that the "column" numbers used to describe positions across the output screen (or across the paper in an output printer) are numbered left to right starting with 0 (zero). Large printers can have 132 columns. Most printing terminals have 80 or 72 columns, while TV monitors may be limited to less (for example, 40 columns).

```
TYPE 2 NUMBERS
? -48,-92
NUMBERS AND SUM ARE:
-48           -92           -140
```



TIME OUT FOR A SELF-TEST

The Self-Test sections in this book are meant to help you check your understanding of the more important ideas. The questions will be mostly in the form of "What does this program do?", or "Write a short program to do the following." These are meant to be pencil and paper exercises. but there will also be test items that say write and *actually* run a program to...etc. Anyone who conscientiously does this (sticking with it until all the "bugs" have been removed and the program works) can be sure of becoming a proficient programmer very quickly.

1. Pretend you're a "computer," and write down the output you would produce when commanded to RUN the following program. This is called "simulating" a computer RUN. It's a good way to check programs. An even better idea is for two people to swap programs they have written and simulate RUNS.

```
10 PRINT “TYPE TWO NUMBERS”
20 INPUT A,B
30 PRINT “SUM =”; A+B, “PRODUCT =”;A*B
40 PRINT “TYPE ANOTHER NUMBER”;
50 INPUT C
60 PRINT “BET YOU CAN’T FIGURE WHERE”
70 PRINT “THESE NUMBERS CAME FROM”
80 PRINT (A+B)*C,A+B*C, A/B+C,A/(B+C)
90 END
RUN

TYPE TWO NUMBERS
?4,2
```

____

____

____

Finish the output.

2. Write a short program that asks for the dimensions (in feet) of a bedroom, living room, and den, and then prints the total number of square feet of carpeting needed.

3. Write and actually run a program that does the same as Problem 2, and also prints the number of square yards of carpet needed, as well as the total cost. (Note: you'll have to add an INPUT statement that requests cost per square yard.)

Let's now go back to our ADDITION PRACTICE program, and examine the output PRINT statements to see what else is possible. There are really five rules to remember about PRINT.

PRINT Rule 1

Anything in quotes is printed exactly as given when the program is RUN. Example:

```
10 PRINT “ADDITION PRACTICE PROGRAM”
            •
            •
            •
140 END

RUN

ADDITION PRACTICE PROGRAM
            •
            •
            •
```

Line 10 causes this output.

PRINT Rule 2

When variable names appear in a PRINT statement *(not in quotes)*, the contents of these locations are printed.

For example, if A contains 47, the statement

```
10 PRINT A
```

will cause the number 47 to appear on the output device (not the letter A).

PRINT
Rule 3

You can mix these two kinds of output (called "items") in one PRINT statement. For example, if A=24 and B=38,

```
10 PRINT "WHAT IS ";A;" + ";B
```

causes the output

```
WHAT IS  24 +   38
```

A *comma* is used between items to place output in separate fields, usually 14 columns wide. A *semicolon* is used to cause items to print as close together as possible, but leaving a space in front for the sign of a number, and leaving one "trailing" blank after the number. If you want a spacing different from either of these, there is a special item called TAB that can be used in a PRINT statement. It will be explained in Section 2.4.

PRINT
Rule 4

A semicolon at the end of a PRINT statement suppresses the normal carriage return (and line feed) that usually takes place automatically when the program is RUN. Look at lines 40 and 50 of the ADDITION program to see how this works:

```
40 PRINT "WHAT IS ";A;" + ";B;"
50 INPUT X
```

If the memory locations A and B contain 42 and 17 respectively, here's what we get when these two statements are executed:

```
WHAT IS  47 +  17?
```

The question mark came from the INPUT X statement, but it did not appear on the next line because the normal carriage return was suppressed by the semicolon at the end of line 40.

PRINT
Rule 5

Arithmetic combinations of variables and numbers (what are called "arithmetic expressions") can be used in PRINT statements. For example you can say:

```
200 PRINT "ANS IS"; 3 +(B*B-4*A*C)/4
```

The combination 3+(B*B-4*A*C)/4 is called an arithmetic expression. If A=5, B=10, and C=2, this statement will produce the output:

```
ANS IS 18
```

This is because 3 + (10 * 10 - 4 * 5 * 2)/4 = 3 + (100 - 40)/4 = 3 + 60/4 = 3 + 15 = 18

++++++++++++++++++++++++++++++++

A Word About Extended BASIC

The explanations so far conform to the minimal standard BASIC defined by a committee of ANSI (American National Standards Institutes). However there are several implementations of BASIC that allow extra features. These are mostly derived from two elegant versions called BASIC-PLUS (Digital Equipment Corporation) and Altair EXTENDED BASIC (MITS Co.). Even if you don't use extended BASIC, it's nice to know how to read it. One of the "project ideas" at the end of this chapter shows how to translate a program written in BASIC-PLUS or EXTENDED BASIC back into ANSI minimal BASIC. The project suggests that you develop a set of notes on the special features of the version of BASIC used on your computer. You'll find that the fundamental techniques of programming remain valid in any language, and that adapting to new language features is about as easy as adapting to new control features in a car.

++++++++++++++++++++++++++++++++

More About Expressions; Operations in BASIC

(a) In BASIC, you can form arithmetic expressions using five operators:

+ is used for addition
- is used for subtraction
* is used for multiplication
/ is used for division
↑ is used for exponentiation
(some systems use **)

Exponentiation means "raise to a power." For example, 3↑4 means "3 to the fourth power" which is the same as 3*3*3*3.

(b) Expression can contain both variables and numbers (called constants). Examples:

```
(1+2+3+4)/N
(A+4)/16-3.213*B
(22.17+78.14)*.06
```

Each of these three lines is a legal BASIC expression.

(c) Parentheses are used in expressions to group things together and show in what order the operations should be done. For example:

(6+15)/3 means 21/3 = 7,
but 6+15/3 means 6+5 = 11.

When there are no parentheses, here are the rules the computer follows:

FIRST PRECEDENCE Exponentiations (if any) are done first.

SECOND PRECEDENCE Multiplications and divisions are done next.

THIRD PRECEDENCE Additions and subtractions are done last.

All operations are done from left to right.

WHEN IN DOUBT, USE PARENTHESES TO CLARIFY YOUR MEANING.

TIME OUT FOR A SELF-TEST

1. Simulate running this program by completing the output.

```
10 INPUT A,B,C
20 PRINT A,B,C
30 PRINT A;B;C
40 PRINT "(A+B)*C=";(A+B)*C
50 PRINT "THE CTH POWER OF A+B IS";
60 PRINT (A+B)↑C
70 END


   RUN

   ?20,-18,8
```

____
____
____
____

2. Write and run a program to convert a person's height into centimeters using the fact that 2.54 cm = 1 in. Here's what a run should look like:

```
RUN

TYPE IN YOUR HEIGHT (FT,IN) ?5,10
THANK YOU.
YOU ARE 177.8 CENTIMETERS TALL
```

END

Let's now explain the remaining key words used in our program. The END statement is simple to use. It is *always* the last statement of any program, and it has no other parts except a line number. Many programmers use 9999 as the in for END.

Note: Strictly speaking, you don't even need the END statement in many versions of BASIC. But we recommend using it just in case you try running your programs on a computer system that requires it.

GOTO

This is also easy to use. It means that the "execution" of your program should depart from the usual rule of executing in the order given by the line number, and instead jump (GO TO) a specified line number. Compare these two examples:

```
10 PRINT 1          10 PRINT 1
20 PRINT 2          20 PRINT 2
30 PRINT 3          30 GO TO 10
40 END              40 END

RUN                 RUN

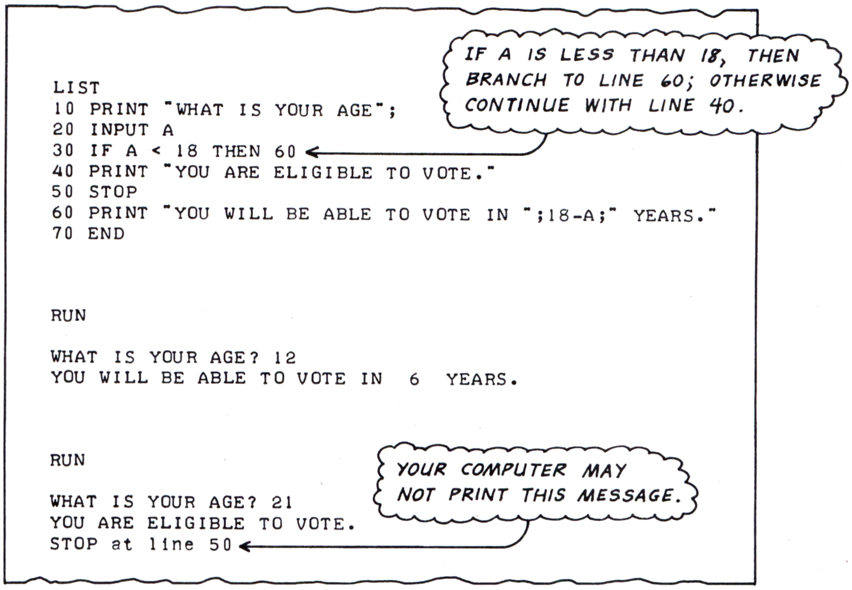
1                   1
2                   2
3                   1
                    2
                    1
                    2
                    •
                    •
                    • etc. (forever!)
```

The GO TO in the second example makes it go on "forever" (of course you can always pull the plug). This is called an "infinite loop." On many systems you can stop such loops by typing "control C" (which means hold down the key marked CTRL, and then also press the C key). A better way out is to use an IF...THEN statement, which we'll explain next.

One last comment. You can type either GO TO or GOTO. This is because BASIC ignores most spaces. However it's good to use spaces whenever they make programs more readable (to people, not computers). We'll have more to say about this at the end of section 2.4.

IF... THEN and STOP

IF... THEN is a set of key words used in what are called "conditional branching" statements. Such statements are what make programs really interesting. To explain how this statement works, let's look at a simple example at the top right of this page.



```
LIST
10 PRINT "WHAT IS YOUR AGE";
20 INPUT A
30 IF A < 18 THEN 60
40 PRINT "YOU ARE ELIGIBLE TO VOTE."
50 STOP
60 PRINT "YOU WILL BE ABLE TO VOTE IN ";18-A;" YEARS."
70 END



RUN

WHAT IS YOUR AGE? 12
YOU WILL BE ABLE TO VOTE IN  6  YEARS.



RUN

WHAT IS YOUR AGE? 21
YOU ARE ELIGIBLE TO VOTE.
STOP at line 50
```

IF A IS LESS THAN 18, THEN BRANCH TO LINE 60; OTHERWISE CONTINUE WITH LINE 40.

YOUR COMPUTER MAY NOT PRINT THIS MESSAGE.

Statement 30 is the IF...THEN statement. Here's what it means:

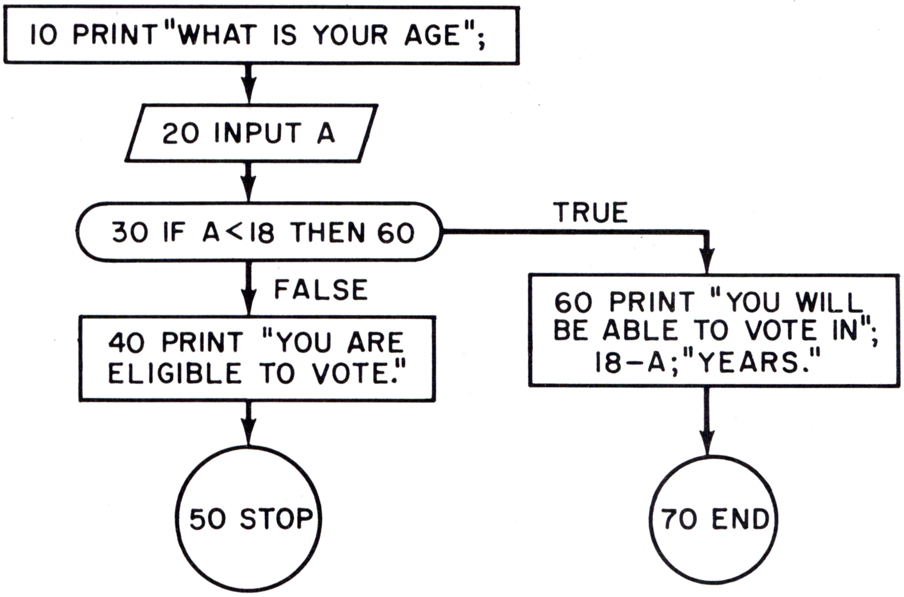
$$30\ \text{IF}\ \underbrace{A<18}_{\text{This is the condition being tested. You read it: "A is less than 18".}}\ \text{THEN}\ \underbrace{60}_{\text{This is the line number that the computer will execute next if the condition is satisfied (true).}}$$

"Satisfied" just means that it's *true*—A *is* less than 18. If the condition is *false* (not satisfied) that is, A is either equal to or greater than 18, then the computer will simply go on to the next statement. In our example it would go on to 40. The statement

50 STOP

means that the computer is to stop executing the program at line 50—it should not go on to the END, but stop right where it is. You can have several STOP statements in a program, but only one END, which *must* be the last statement.

We can illustrate the logical flow of this program with a diagram called a flowchart.


10 PRINT "WHAT IS YOUR AGE";
20 INPUT A
30 IF A<18 THEN 60
TRUE
FALSE
40 PRINT "YOU ARE ELIGIBLE TO VOTE."
60 PRINT "YOU WILL BE ABLE TO VOTE IN"; 18-A;"YEARS."
50 STOP
70 END

The most important box in our diagram is the sausage-shaped "decision" box, which shows the two possible branches or paths the computer can take. It represents the IF...THEN statement.

Here is how the various conditions are written in BASIC, using the relations <, > ,and =.

A<B means "A is less than B"
A>B means "A is greater than B"
A=B means "A is equal to B"

You're also allowed to use the following combinations:

A <= B means "A is less than B *or* A is equal to B"
A >= B means "A is greater than B *or* A is equal to B"
A <> B means "A is not equal to B".

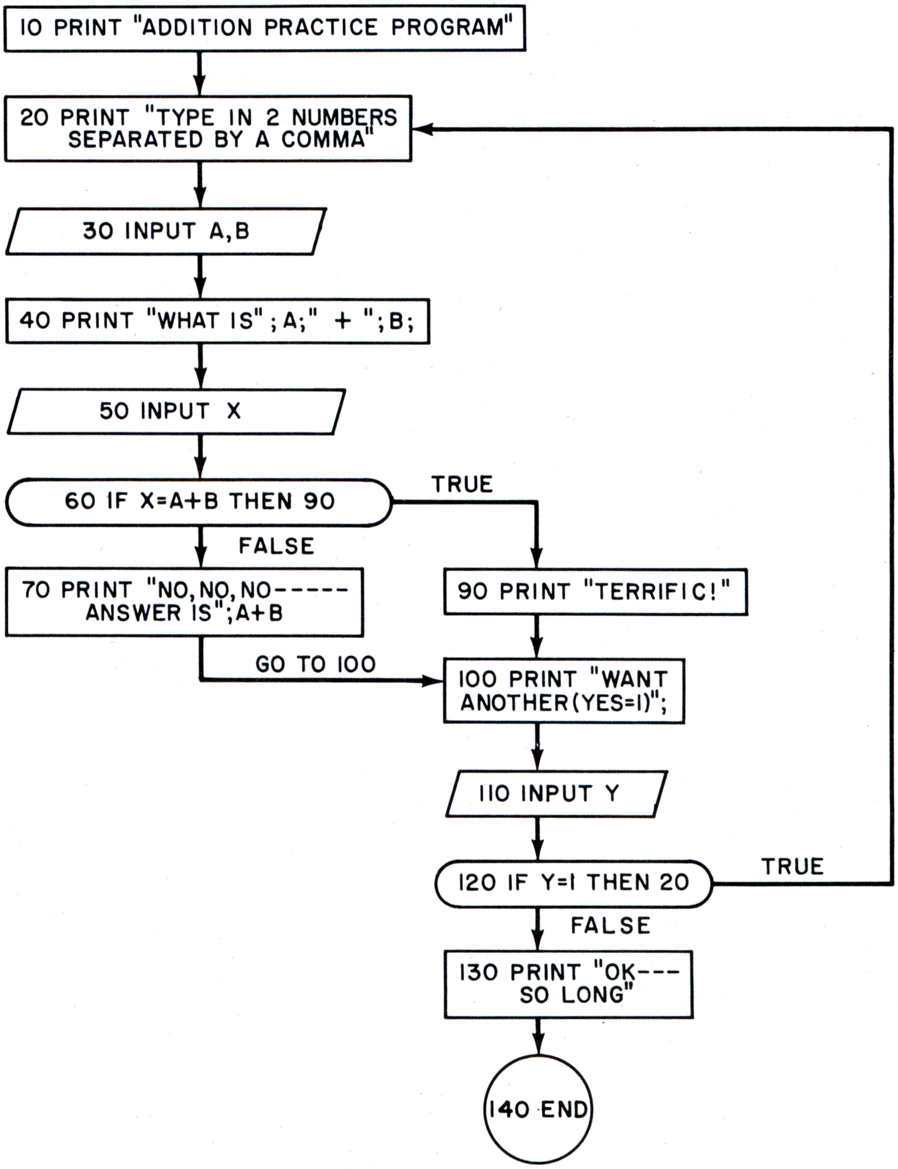
One last (but very important) thing: the parts of a condition can also be expressions. All of the following are correct IF...THEN statements:

```
100 IF A+4>A-B THEN 120
100 IF X<=B*B-4*A*C THEN 500
100 IF 3*X↑4<.0001 THEN 400
```

Meanwhile, Back at Our Main Example...

Let's now return to our ADDITION PRACTICE program, and show it in flowchart form. It has two conditional "decision" boxes, one to decide if the answer given to the problem is correct, and the other to decide whether the user wants to do another problem. You'll notice that the GOTO statement doesn't get a box. It's simply written next to the line that shows where the program "goes to" at that point.

The best way to follow this flowchart is to start at the top and trace the arrows. Choose specific numbers for A and B. Trace through the flowchart for two different answers for X, a correct one where X=A+B is *true*, and an incorrect one where X=A+B is *false*.


10 PRINT "ADDITION PRACTICE PROGRAM"
20 PRINT "TYPE IN 2 NUMBERS SEPARATED BY A COMMA"
30 INPUT A,B
40 PRINT "WHAT IS"; A;" + ";B;
50 INPUT X
60 IF X=A+B THEN 90
TRUE
FALSE
70 PRINT "NO,NO,NO----- ANSWER IS";A+B
GO TO 100
90 PRINT "TERRIFIC!"
100 PRINT "WANT ANOTHER(YES=1)";
110 INPUT Y
120 IF Y=1 THEN 20
TRUE
FALSE
130 PRINT "OK--- SO LONG"
140 END

FINAL SELF-TEST FOR SECTION 2.1

1. Enter and actually RUN the ADDITION PRACTICE program. See if your favorite grade school student can use it, or even suggest some improvements.
2. Modify the program so it gives practice in multiplication.
3. Modify the program so it gives practice in adding three numbers at a time.

2.2 HOUR 2: ADDING A "COUNTER" TO YOUR PROGRAM; PRINTING SCORES

The previous program required the "user" (the person running the program) to repeatedly answer the question WANT ANOTHER? This could get pretty tiring for someone who was training for an arithmetic quiz and wanted to do lots of practice problems. Here's a MULTIPLICATION PRACTICE program that allows you to say how many problems you want right at the start. It also prints the percent of correct answers at the end.

```
10 PRINT "MULTIPLICATION: HOW MANY PROBLEMS";
20 INPUT N
30 LET R=O
40 LET K=1
50 IF K> N THEN 150
55PRINT "TYPE IN 2 NUMBERS";
60 INPUT A,B
70 PRINT "WHAT IS THE PRODUCT"; A;" * "; B;
80 INPUT X
90 IF X =A*B THEN 120
100 PRINT "OH, MY! THAT'S..... WRONG."
110 GO TO 140
120 PRINT "OH,MY! THAT'S..... RIGHT!"
130 LET R=R+1
140 LET K=K+1
145 GO TO 50
150 PRINT "FINISHED: YOUR SCORE IS"; R/N* 100; "%"
160 END
```

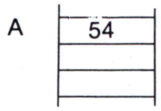
Something new has been added!

LET

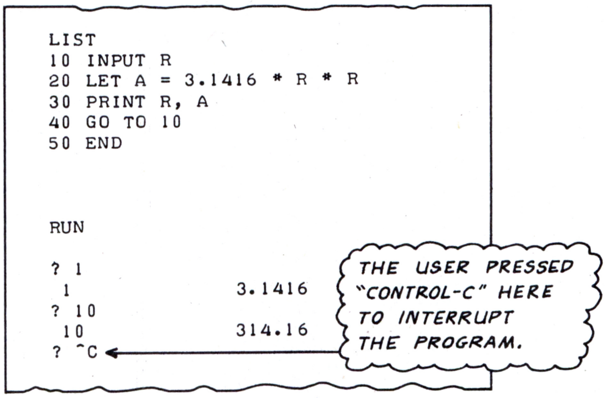
This program uses a new key word, LET. As you've probably guessed by now, a computer program can't do much until data has been stored in the proper memory locations. There are three ways to do this in BASIC. The first is an INPUT statement that lets the person running the program supply this data. The second is the LET statement which allows the program itself to load data in a memory location (the third method uses the READ and DATA statements explained in section 2.5). LET statements are called *assignment* statements. The statement

```
10 LET A=54
```

sets up a memory location called A and then "assigns" the number 54 as its contents:



An important feature of the LET statement is that the right side can be any arithmetic expression. For example here's a program that calculates the areas of circles with radii R supplied by the user:



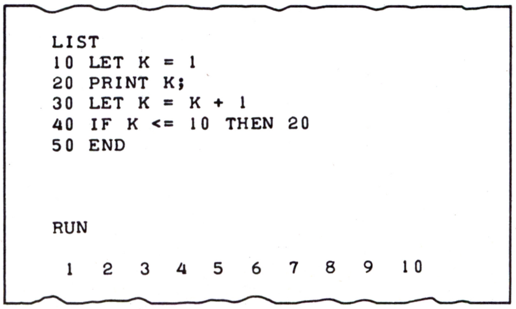
```
LIST
10 INPUT R
20 LET A = 3.1416 * R * R
30 PRINT R, A
40 GO TO 10
50 END


RUN

? 1
 1                   3.1416
? 10
 10                  314.16
? ^C
```

THE USER PRESSED "CONTROL-C" HERE TO INTERRUPT THE PROGRAM.

Now here's the most interesting feature of LET. You can have the variable on the *left* side of a LET statement become an updated version of its previous value given on the right side. Watch this:



```
LIST
10 LET K = 1
20 PRINT K;
30 LET K = K + 1
40 IF K <= 10 THEN 20
50 END


RUN

 1  2  3  4  5  6  7  8  9  10
```

See what happened? K started out as 1. Then it was printed in line 20. Then, in line 30, K was changed to 2 (a value equal to its previous value + 1). The IF...THEN in line 40 makes the whole process repeat until K is greater than 10.

Suggestion: you should always think of the LET statement as doing what's to the *right* of the + sign first, and *then* storing this value in the variable on the left side. Think of LET K=K+1 as meaning: K ← K+1

New K   Previous K

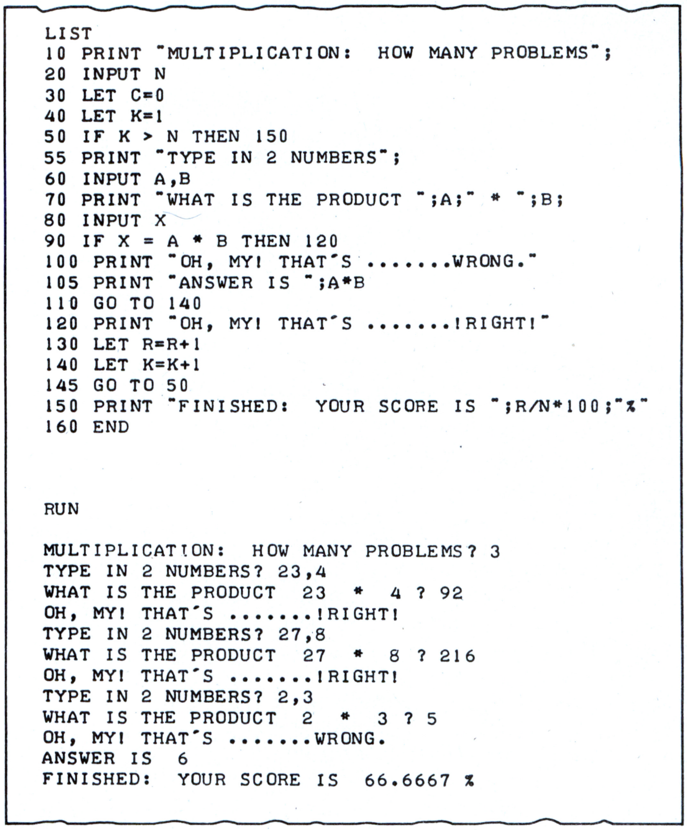
The above process is called *incrementing* K. In our case we increment by 1, but of course any increment could be used.

Now Back to Our Main Example

From the discussion of LET, you can now see how our MULTIPLICATION PRACTICE program works. K is a counter that keeps track of how many problems are done. When it finally becomes greater than (>) N, the number of problems which the user wanted to do, the program branches to line 150 and finishes up. Our other counter is R, which keeps track of how many problems the user gets right. R only gets incremented (in line 130) if the answer X is correct (that is, when the condition in line 90 is true). This makes the program brach to line 120, followed by line 130 where the incrementing of R takes place.

The precent of correct answers is printed with the expression R/N*100 in line 150. For example, if you do 20 problems (N=20), and get 14 right (R=14), then R/N*100 = 14/20*100 =.7*100 = 70%.

Here's a sample RUN of the MULTIPLICATION PRACTICE program:



```
LIST
10 PRINT "MULTIPLICATION:  HOW MANY PROBLEMS";
20 INPUT N
30 LET C=0
40 LET K=1
50 IF K > N THEN 150
55 PRINT "TYPE IN 2 NUMBERS";
60 INPUT A,B
70 PRINT "WHAT IS THE PRODUCT ";A;" * ";B;
80 INPUT X
90 IF X = A * B THEN 120
100 PRINT "OH, MY! THAT'S .......WRONG."
105 PRINT "ANSWER IS ";A*B
110 GO TO 140
120 PRINT "OH, MY! THAT'S .......!RIGHT!"
130 LET R=R+1
140 LET K=K+1
145 GO TO 50
150 PRINT "FINISHED:  YOUR SCORE IS ";R/N*100;"%"
160 END



RUN

MULTIPLICATION:  HOW MANY PROBLEMS? 3
TYPE IN 2 NUMBERS? 23,4
WHAT IS THE PRODUCT  23   *   4 ? 92
OH, MY! THAT'S .......!RIGHT!
TYPE IN 2 NUMBERS? 27,8
WHAT IS THE PRODUCT  27   *   8 ? 216
OH, MY! THAT'S .......!RIGHT!
TYPE IN 2 NUMBERS? 2,3
WHAT IS THE PRODUCT  2   *   3 ? 5
OH, MY! THAT'S .......WRONG.
ANSWER IS  6
FINISHED:  YOUR SCORE IS  66.6667 %
```

More About BASIC Varibles

This is a good time to answer a question you may have had about what "names" can be used for BASIC variables. The answer is that a variable can be

(1) Any single letter; for example, A,B,C,D,..., Z.

(2) Any single letter followed by a single decimal digit; for example, A1, A2, A9, B4, B7, Q7, Q8, Z0, Z3, Z4, Z5. This means that there are 26 + 10*26 = 286 possible "legal" variables names (additional names for "string" variables will be introduced in Chapter 4.)

SELF-QUIZ

1. Simulate running this program and write down the output:

```
10 LET A=10
20 LET B=10
30 LET K=1
40 IF K> 5 THEN 100
50 PRINT K,A,B
60 LET A=A+2
70 LET B=A+B
80 LET K=K+1
90 GOTO 40
100 END
```

2. Write a program that acts like (simulates) an adding machine.
A run should look like this:

```
RUN

ADDING MACHINE SIMULATOR
ENTER NUMBERS TO BE ADDED AFTER EACH ?
ENTER 0 (ZERO) WHEN FINISHED

?142.83
?96.21
?895.04
?7.22
?0
THE NET SUM= 1141.30
```

Hint: Set up an "accumulator" variable for the sum with an initial value 0 (40 LET S=0). Then after you input each number (50 INPUT X), add it to the latest value in the accumulator (60 LET S=S+X).

3. Write and RUN a program to verify your checkbook balance. Hint: There's nothing to do! Simply use the above program, and enter deposits as positive numbers (?605.42), and checks or bank charges as negative number (?-49.52). ■

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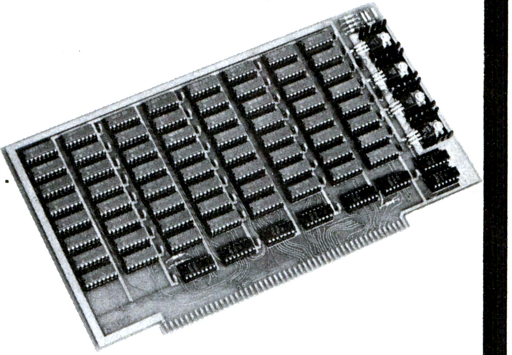

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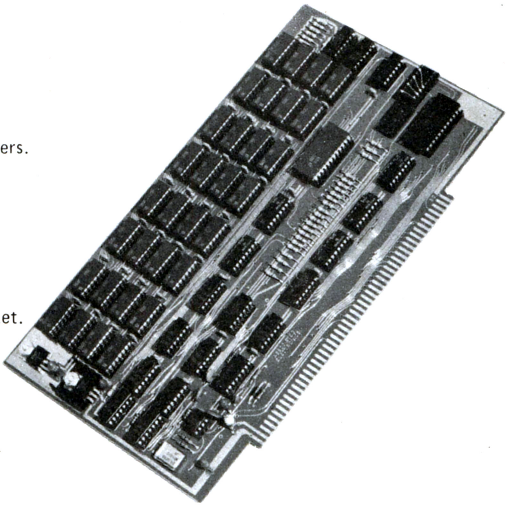

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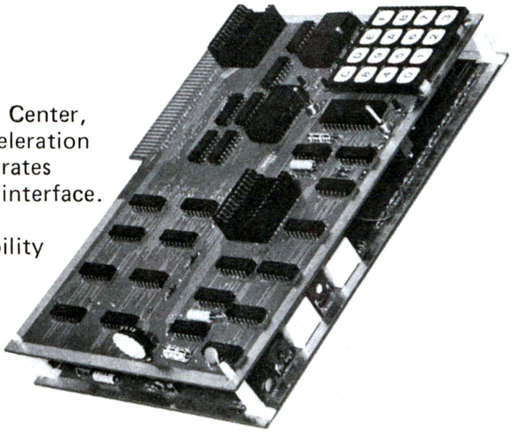

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Computers in Research*

Carl Hammer, Ph.D.
Director, Computer Sciences, UNIVAC

The data processing and computational work done by approximately 100,000 machines in the United States alone could no longer be carried out by hand; it would take approximately 400 billion people (hundred times the world's total population!) to tackle this workload of our complex, mind-amplifying society!

Introduction

Since the middle of this century, people around the world have found themselves living in complex societal structures which make increasing demands on our ability to process data and to perform calculations on a large-scale. Before the advent of the electronic computer, countless complex and laborious computations were carried out by hand; they are now turned over to our electronic wizards, freeing the minds and hands of millions of people from rote and drudgery and releasing them to do more original and productive work.

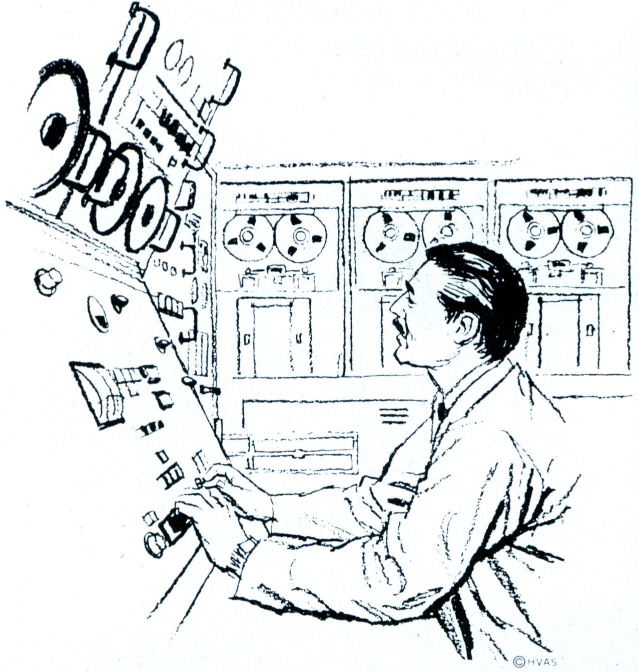
Between 1942 and 1946, Drs. J. Presper Eckert and John W. Mauchly, of the Moore School of Electrical Engineering at the University of Pennsylvania, conceived the idea of an Electronic Numerical Integrator and Calculator. They completed its construction with a team of ten engineers, under the overall direction of Dr. John G. Brainerd, Director of the Moore School. The ENIAC had half-a-million soldered joints, 18000 vacuum tubes, 6000 switches, and 500 electric terminals. It could add decimal numbers at the rate of 5000 per second and was soon put to work, solving mathematical research problems in ballistics and aerodynamics. Its astounding computing power was harnessed by George Reitwiesner in 1948 to calculate PI to 2000 decimals, during the labor day weekend; 215 years earlier, Leonard Euler had labored for two full years, getting the first 600 decimals of PI, at which time he concluded that "no one would ever be able to do better."

With the addition of general purpose logic and more versatile input-output subsystems, the UNIVAC I (1952) saw much activity in the world of pure and applied research. Random number generation to facilitate statistical experiments saved many man-hours in strength of materials studies and other engineering applications. Manipulation and inversion of large matrices permitted us to solve pipe stress problems thousand times faster than before. X-ray spectroscopy, sequential regression, factorial analysis, operations research, and modelling—to mention only a few—were some of the early applications in the R&D community.

The mind-amplifying power achieved by today's machines boggles even the experts' imagination. The data processing and computational work done by approximately 100,000 machines in the United States alone could no longer be carried out by hand; it would take approximately 400 billion people (hundred times the world's total population!) to tackle this workload of our complex, mind-amplifying society! In our information-rich world manipulation and processing of data (in their most general sense) has become a sine-qua-non for progress and survival. With the addition of communications, today's electronic systems presage the "final" transition to a global realtime community.

When Christopher Columbus set foot on the New World in 1492 he did not know where he was nor by what route he had arrived. It took the world years to learn of his courageous journey and decades to adjust to his discovery. When Neil Armstrong stepped upon the surface of the moon in 1969, he knew exactly where he was, having followed a precisely planned journey, and the whole world was watching him in realtime! In less than five hundred years man's ability to communicate had advanced from its most primitive forms to an astonishing level of sophistication, made possible only by the nearly two-hundred computers that comprise the NASA Apollo System.

Computers in research have now become one of man's most powerful tools. With their help the international scientific community is constantly developing new applications or formulating new results and discoveries. The success of our scientists extends to every conceivable field of endeavor. It ranges from classical (mechanical and electrical) engineering to research in biology, chemistry, and physics. We find applications in the social sciences, in management of large systems, and even in the control of societal processes themselves. As high-level decision makers in government and industry face increasingly complex situations, they are turning to the development of large data bases and sophisticated models; with these new tools they expect to do a better job of managing our limited resources and to develop optimal strategies for the future.



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*Excerpts from Sperry Seminar Presentation, Moscow, USSR, May 1974

The Future

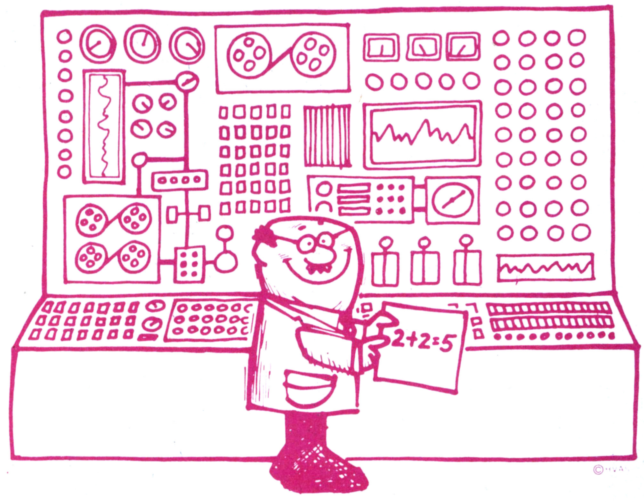
The System Dynamics Laboratory at the Massachusetts Institute of Technology has developed mathematical models of world systems in which computers project data as far ahead as 200 years. System dynamics, a method of computer simulation designed to handle complex social systems, had its roots in the work of Vannevar Bush, who more than 40 years ago built a differential analyzer to solve simple engineering problems. At about the same time, Norbert Wiener was studying feedback systems and coined the term Cybernetics. During the 1940's Gordon S. Brown created M.I.T.'s Servomechanism Laboratory where the theory of feedback systems was developed. Jay W. Forrester was one of the first to use digital computers to simulate such systems. He applied systems dynamics to business organizations, management, cities, and the world, in books appropriately entitled, *Industrial Dynamics, Urban Dynamics,* and *World Dynamics* Professor Forrester believes that simulation of global models by computers combines both the capabilities of the human mind and the computer to describe social systems, capitalizing on the particular strengths of each. The mind formulates the structure and the computer traces out the interactions.

A team headed by Dennis L. Meadows predicted that the world is headed for social and economic collapse in about 50 years if action is not taken now to curtail population and economic growth rates. In his "Limits of Growth" he concludes that growth cannot continue indefinitely on a finite planet. He warns that the earth's natural resources will soon be depleted and the environment will be so polluted that civilized life will no longer be possible.

The propositions set forth by Forrester and Meadows have evoked a storm of protest and criticism. Burnham Beckwith, a social scientist and the author of "The Next 500 Years," notes that the use of computer models to predict the future produces results that depend entirely upon the data and the assumptions provided to the computer. He states that the conclusions reached by Forrester and Meadows are based on "arbitrary and pessimistic assumptions." For every pessimistic book about the future, there are scores taking the optimistic point of view. Some futurists project drugs that will increase the level of human intelligence, electrical stimulation of the brain to bless man with constant happiness, and youth pills to lengthen our life span to 150 years. With the help of computers, they say, our research laboratories will unravel the mysteries of photosynthesis and man will be able to produce abundant food supplies in the chemical laboratory. Protein will be extracted from old tires, newspapers, compost and seaweed; meat will be synthesized from vegetable substances such as soy beans. Man will, these futurists go on, control the weather by generating, for example, abundant rain in arid regions. Huge nuclear desalting plants are envisioned that will enable production of enough food to feed millions of people in areas that once were deserts. The futurists even see whole cities under the seas and also floating on the oceans. Fusion power should be available long before coal and oil run out. Our transportation systems will operate on electrical energy which is generated at some central stations and transmitted by radio waves. The introduction of electronic data processing systems into our society has already caused profound changes in its structure and organization. Real-time systems and time-sharing make the power of the computer available to untold thousands at their desks and even in their homes. A steadily growing number of commercial users rely on global and spatial electronic communication systems, as much as scientists employ them to obtain, store, and disseminate large quantities of data and pictures. And yet, this is only the beginning; it will take at least another decade before the full impact of electronic systems upon human society can be properly assessed.

We must understand that we are in the midst of a transition from an automated to a cybernetic society. By the end of this decade, electronic systems and broadband communications will affect practically every aspect of human endeavor. Information utilities and real-time systems will be available to the public in the same sense that other utilities today service our homes and offices. Linked global and spatial communication systems will serve government officials, businessmen, scientists, students, even our children, furnishing them the ability to "Converse" with computers as readily as they now talk by telephone. With apologies to Norbert Wiener, we conclude that homo sapiens, if he is to survive, must learn to make intelligent use of our not-yet-very-intelligent machines. ■

We are in the midst of a transition from an automated to a cybernetic society.



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Supertoys: A New Approach to Learning Mathematics

Many "new products" are interesting—a few are also useful, but only rarely can one be described as revolutionary. This review is longer than most because both the products and the ideas that motivated them may indeed revolutionize the pedagogy of mathematics fundamentals.

Dr. Seymour Papert, the mathematician and child psychologist who is codirector of the Artificial Intelligence Laboratory at the Massachusetts Institute of Technology, has been working to harness the intuitive mathematical ability of children at play to create a computerized learning environment where every student is successful and no one fails.

To appreciate the theory of Dr. Papert, one must first understand his permise: The best way to teach mathematics to youngsters is by presenting it as a second language rather than a unique, number-oriented discipline; and the best way to learn a language is to go to a land where that language is the primary means of communication. Dr. Papert suggests that a child who has trouble understanding the number process is often said to display a lack of inherent mathematical ability. However, the French teacher is unable to pigeonhole slower learners in this way, since everyone knows that in France all children learn to speak French. Dr. Papert believes that every child has a similar mathematical intuition. He can, for example, select the proper speed and distance that must be run to catch a baseball. To accomplish this task he must calculate a number of variables both instantly and intuitively. By programming a robot turtle to move across the floor in a certain way, the same child begins to make a formal model of his own behavior. The important point is that the child is instructing the turtle through the computer, in a language of mathematics.

Grade school children learn mathematical concepts with the "Mathland" turtle at the Artificial Intelligence Lab at MIT, Cambridge.

Papert and his colleagues have devised some of the components of what they call "Mathland," an arena where fourth, fifth, and sixth graders of below-average mathematics ability (by traditional standards) play with "supertoys" by communicating with computer

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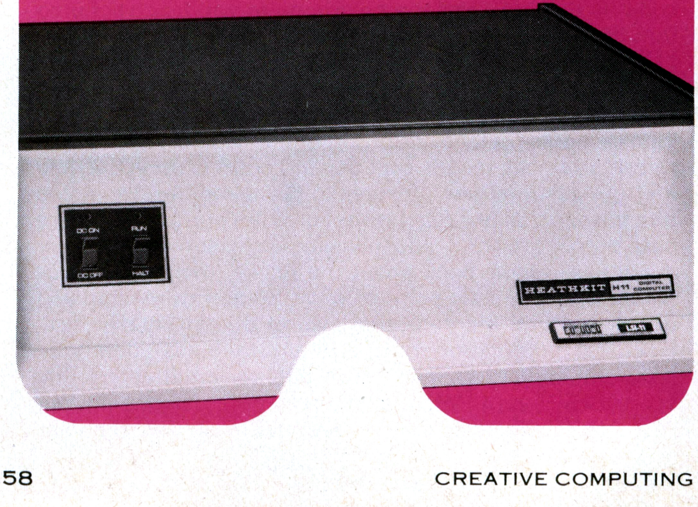

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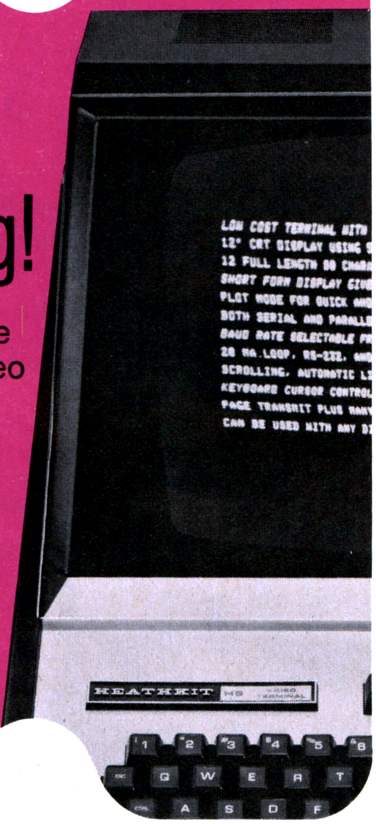

"turtles" that move along the floor in paths predetermined by the children's computer programs. Typically, a child's excursion into Mathland might begin with an introduction to the computer, most likely by using the robotic turtle to draw geometric patterns on a large paper on the classroom floor. By typing extremely simple instructions on a typewriter-like terminal, first the teacher and the student can command the turtle. The rather remarkable turtle is equipped with "sense organs" that accept electrical signals from the computer, a horn, a light, "touch" sensors, and a pen that can be lowered to trace the turtle's path. Soon the student can learn to write programs that will cause other Mathland supertoys to behave as he wants. He can, for example, choose to use a visual display in which the turtle is represented by a triangle. Several students can work independently with turtles, visual displays, or music boxes, depending on the timesharing capacity of the computer being used.

Using LOGO, a programming language written especially for Mathland, elementary school children have written a host of impressive programs. They have filled the display screen with such things as animated flowers "growing," a family of swans, spider webs, and moving cars. The music boxes have been used to play new renditions of old tunes as well as original music composed by the students. Turtles have done everything from running errands to drawing rather sophisticated geometric patterns.

Certainly the interactions of computers and children are no longer unusual news items. It is Papert's contention, however, that the potential of the computer as a mathematical tool has not yet been realized by most educators. He suggests that the primary educational application of the computer has been to provide students with drill and practice in mathematics fundamentals. In Mathland, the student is allowed to change roles with the teacher. The student can then teach his computer to do whatever he wants, being limited only by his imagination. Hence at an early age, the student can experience a glimmer of the usefulness of mathematics and the potential of the computer. Mathland is not all fantasy, as you might suspect. Dr. Papert's group has been conducting Mathland experiments at MIT for the past three years. During that time portable Mathlands have been established at several New England elementary schools as well as at some schools in England. Mathland programs using the LOGO language can be run on both small and large computers—a PDP-11 minicomputer and a million-dollar DECsystem-10 have both been used. Papert's work indicates that computer size does not have a great effect on the children. However, size must be considered because larger computers permit larger student groups to work at one time. Papert suggests that if a school does not have access to a large computer, it would do well to spend the relatively small amount of money necessary to buy a mincomputer and the related equipment.

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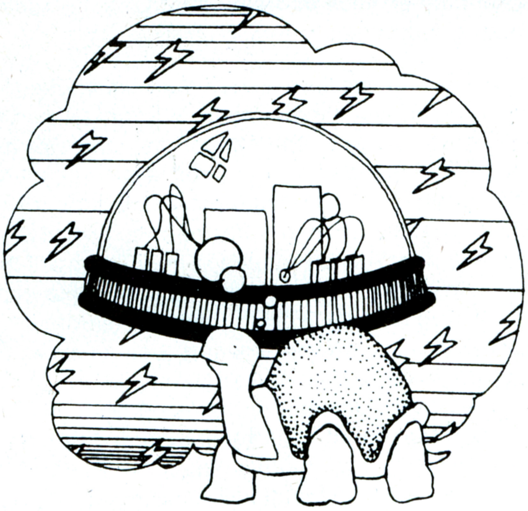
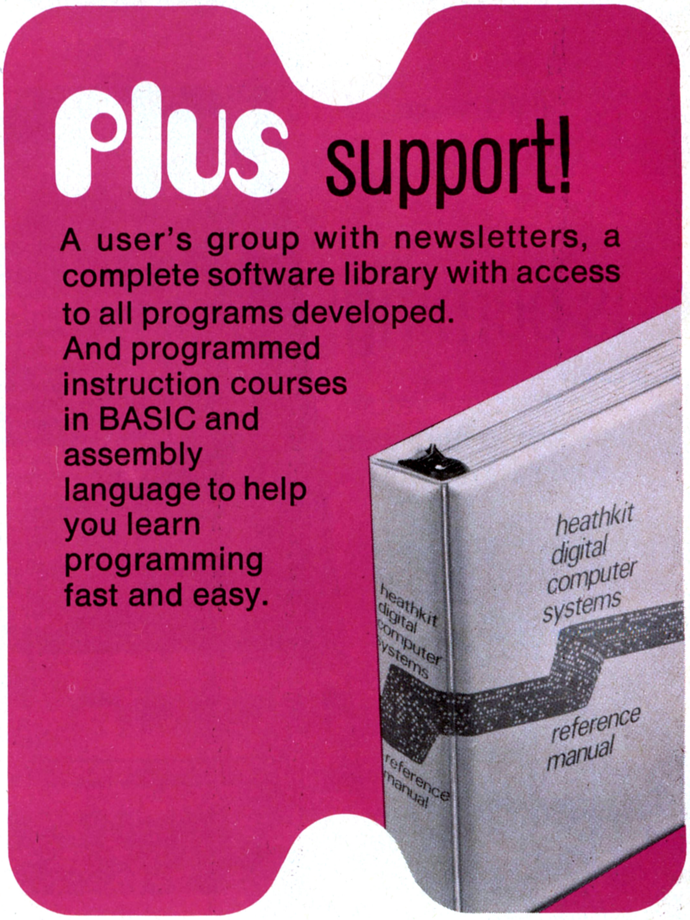


The other turtle equipment has recently been made available through a newly formed company—General Turtle, Inc. (Really!). General Turtle can supply you with turtle, music box, video plotter, and a controller for all the devices—everything but the computer—for $4,000. If you would rather proceed more cautiously into the world of supertoys, the devices are also available separately.

Just as the Mathland concept differs from "learn by rote" number instruction, so the results elude standard interpretations for evaluating the mathematical progress of the children. However, qualitative evidence of Mathland's worth can be found in the snowballing enthusiasm of the people—teachers, students, and parents—who have taken part in one or more of Mathland programs, and in the ever-growing number of requests from educators and parents for acceptance in future Mathland projects. Evidence is also reflected in the eager eyes of youngsters watching their computer programs put to use in their own Mathland. Dr. Papert feels that the ultimate accomplishment of the goals of Mathland will "present a grander vision of an educational system in which technology is used not in the form of machines for processing children but as something the child himself will learn to manipulate, to extend, to apply to projects: thereby gaining a greater and more articulate mastery of the world, a sense of the power of applied knowledge and a self-confidently realistic image of himself as an intellectual agent."—Walter Koetke. ■

Reprinted from *The Mathematics Teacher*, December 1973.



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University planning committees start with two or three plans of action and invariably succeed in narrowing them down to five.

M. Dale Baughman

****

The harder I work on Monday, the lighter my load is on Tuesday and the tireder I am Monday night.

M. Dale Baughman

You and the Computer

C. W. Spangle
President, Honeywell Information Systems

In his book, *Future Shock,* Alvin Toffler divided man's time on earth into 800 lifetimes. The lifetime we're in now, Number 800, has produced more knowledge and advancement than the previous 799 combined. And it has done so with the aid of the computer. But for 80 to 90 per cent of the population, the computer remains a mystery. Most people still think of computers as the "giant brains" portrayed in science fiction thrillers of the 1950's.

It is a little short of astounding that the computer, which affects the daily lives of all of us, can remain such a misunderstood box full of wires, silicon chips, integrated circuits and magnets. Those who are afraid of the computer often forget that. They tend to believe that the devices which make the computer capable of receiving, storing, processing, and disseminating information at fantastic speed and accuracy will turn us into a goldfish bowl, data bank society.

Part of the blame for this kind of thinking lies with the computer industry itself, for perpetuating the mystery that surrounds its wonderful tool. It must be remembered that the computer is simply that — a tool used by men that can serve to expand the capabilities of the human brain. Other tools have helped ease man's physical labor. The computer is helping man's mind. Its potential is boundless and its applications limited only by man's imagination. As our imagination and experience expand, so will the computer's benefit to society.

This can only be done by making people — everyone — more familiar with this tool. We should all recognize that the computer is a key factor in causing, and coping with, today's era of rapidly-accelerating change and we should all gain more understanding of it so that we can put it to more and more sophisticated uses. One example of how present knowledge of computer functions is not being used lies in the lack of widespread application of computers in medical diagnosis and treatment. Although computers perform hospital administrative chores and sometimes act as second nurses to monitor patients, doctors still balk at the prospects of a computer helping them in medicine. The reason for this is simply that doctors are part of the 90 per cent of the population that is, for the most part, ignorant of computers.

The answer to society's only casual interest in the accomplishments of science and technology must lie in education, formal and informal, at all levels. If the computer is to become the universal information tool, helping man solve his problems and helping him to cope with a more complex life, then man must learn about the computer. To be sure, the computer must learn a little more about man and we must adapt the computer, especially terminals, to meet human frailties. We must learn about computers so we won't be afraid of them. The biggest educational task lies with humans. Already, in the area of formal education, more and more schools are using computers as an aid to instruct students, and the use of computers in an educational environment is filtering down from the college level to the high school and even grade school level. Perhaps in twenty years, we will even see grade schoolers manipulating a computer terminal with the same fervor they now devote to television.

The computer must be brought to the people who will ultimately be its beneficiaries. People of all ages must learn what computers are, and what they can and cannot do. Familiarity in this case will not breed contempt; it will build understanding and acceptance. ■

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The second in this five-part series on Computer Assisted Instruction shows how the score can be used to tailor the type and difficulty of problems to the individual student.

CAI: Structuring the Lesson to the Student

David H. Ahl

In Part 1 of this series we looked at how various types of arithmetic problems can be generated. In this section we'll look at the use of scoring to vary the ratio or type and difficulty of problems.

Let's look at the performance of 3 students on 4 types of problems. We'll assume that each student has completed 100 problems, 25 of each type. Here are the percentage missed (incorrect) of each type of problem.

Problem Type	*Student* 1	2	3
Vertical addition	0%	8%	24%
Horizontal addition	4	12	32
Vertical subtraction	0	12	36
Horizontal subtraction	8	20	48

It is obvious that Student 1 is doing quite well—3 problems wrong out of 100. It is equally obvious that Student 3 is having trouble, with 35 out of 100 problems incorrect. Student 2 is somehwere in between.

Now our situation is that we'd like to alter the ratio of problems presented to each student in order to give them additional practice on the types with which they're having trouble. A straightforward way of doing this is to come up with a ratio based on problems missed previously (or in a pre-test). Let's try this for Student 2:

Problem Type	*% Wrong*	*Ratio*	*New Distribution of Problems*
Vertical addition	8%	2	16.7%
Horizontal addition	12	3	25.0
Vertical subtraction	12	3	25.0
Horizontal subtraction	20	4	33.3
		12	100.0%

Good approach? Well, maybe. Except that Student 1 would get 67% horizontal subtraction and 33% horizontal addition and no other types. How then does the student advance to a higher grade-level in vertical subtraction? Clearly, we've overlooked something. But before discussing this, let's consider another factor.

If a student misses 5 out of 5 fraction problems on Monday and then misses 0 out of 5 on Tuesday, what does that mean? Does this mean:

(1) The overall score is 50% and the student needs more practice.

(2) The student learned the concept after a dismal performance Monday and now needs no further practice.

```
HI.  TØ STØP, TYPE 9999 FØR YØUR ANSWER.
WHAT IS YØUR GRADE LEVEL? 2.5

    150
 +   33
-------
? 183
CØRRECT !!

HERE'S ANØTHER...

     38
 +   54
-------
? 82
WRØNG, TRY AGAIN.

     38
 +   54
-------
? 92
CØRRECT !!

HERE'S ANØTHER...

     30
 +   68
-------
? 98
CØRRECT !!

HERE'S ANØTHER...

    100
 +   94
-------
? 194
CØRRECT !!

HERE'S ANØTHER...

    135
 +   55
-------
? 190
CØRRECT !!

HERE'S ANØTHER...

     13
 +   52
-------
? 65
CØRRECT !!

HERE'S ANØTHER...

      6
 +  119
-------
? 9999
ØKAY.  SØ LØNG.  HØPE YØU ENJØYED IT.
YØUR GRADE LEVEL IS NØW   2.55943
```

Student inputs his grade level from the last session.

These 3 problems helped the student advance his grade level slightly.

(3) The student lucked out on Tuesday and got a batch of trivial problems.

What would be the explanation if the scoring was reversed; that is 5 correct Monday and 5 missed Tuesday? The point is, and this ties in with the previous scoring situation, that we need a moving-average type of scoring system which meets the following criteria:

(1) It weighs the most recent performance most heavily, but does not ignore previous performance.

(2) It allows a student to advance to more difficult problems than their current mastery level.

(3) It continues to give some minimal practice on problem types the student has already mastered.

(4) It is simple to understand for both student and teacher (or parent or administrator).

If we proceed along traditional lines, we'll have to determine what type of problems a student should be receiving practice in, his score on each in the last session, and his score in the sessions before that—a tricky bit of record-keeping. But what if we could come up with a single measure for each type of problem, say "estimated grade level," which incorporated all of the above measures?

Consider the following "scores" for Derek Carlson:

	Grade Level						
	1	2		3	4	5	6
Vertical addition			X				
Horizontal addition		X					
Vertical subtraction				X			
Horizontal subtraction		X					

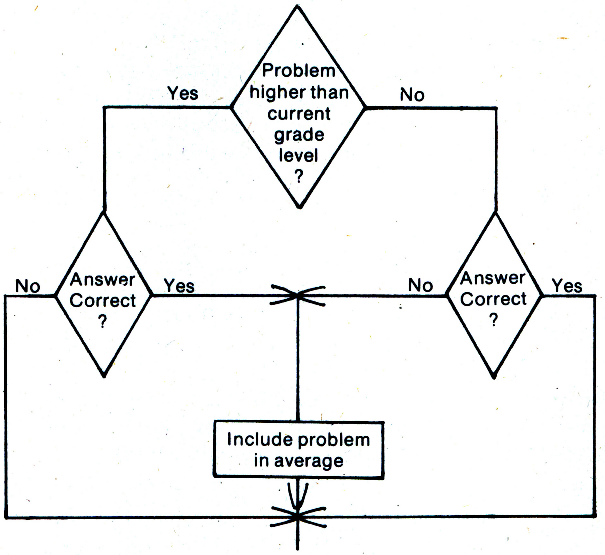
If Derek is halfway through Grade 2, he is behind in 2 problems types, ahead in 1 and on-target with 1. The nice thing for us is we have all the information we need to give him more problems at the "right" level. Naturally this assumes we know what problems of what complexity are being done at every grade level.

So how do we score? Simply by letting the most recent problem done count 10% of the overall score (of that problem type) if the problem was correct and over his current grade level or if it was incorrect and under his current level. The problem is ignored if he got it wrong and it was over his current level, or got it right and it was under his grade level. In other words:

		Answer	
		Right	*Wrong*
Problem	*Higher than grade level*	Raise student grade level	Ignore
	Lower than grade level	Ignore	Lower student grade level

At first glance this may look complex and even somewhat goofy, however what it really means is that a student is "rewarded" for doing a problem beyond his grade level but he is not penalized if he can't do it. On the other hand he is penalized if he can't do a problem lower than his grade level, but not rewarded for doing one lower.

A flowchart of this process is shown below.


Problem higher than current grade level ?
Yes
No
Answer Correct ?
No
Yes
Answer Correct ?
No
Yes
Include problem in average

```
10 RANDØMIZE
15 PRINT "HI.  TØ STØP, TYPE 9999 FØR YØUR ANSWER."
20 PRINT "WHAT IS YØUR GRADE LEVEL";
30 INPUT G1
40 G2=G1-.5+RND(0)
50 R=INT(2*1.73*G2^4)
60 A=INT(100*G2*RND(0))
70 IF A>R THEN 60
80 B=R-A
100 PRINT
110 PRINT "      ";A
120 PRINT "   +  ";B
140 R=A+B
200 PRINT "-------"
210 INPUT G
220 IF G=R THEN 310
225 IF G=9999 THEN 500
230 W=W+1
240 IF W>1 THEN 270
250 PRINT "WRØNG, TRY AGAIN."
260 GØTØ 100
270 PRINT "YØU MISSED THAT ØNE TWICE."
280 PRINT "THE CØRRECT ANSWER IS ";R
285 W=0
290 IF G2>G1 THEN 400
300 GØTØ 350
310 W=0
320 PRINT "CØRRECT !!"
330 IF G2<G1 THEN 400
350 G1=.9*G1 + .1*SQR(SQR(R/2/1.73))
400 PRINT \ PRINT "HERE'S ANØTHER..."
410 GØTØ 40
500 PRINT "ØKAY.  SØ LØNG.  HØPE YØU ENJØYED IT."
510 PRINT "YØUR GRADE LEVEL IS NØW ";G1
999 END
```

G2, the grade level of the problem to be done is ± ½ a grade of the student's level, G1.

Statements 50 and 60 calculate the addends of the problem.

Statement 350 gives us a moving grade level average.

We said that if a problem is to be counted in the student's overall average, it counts 10% of the total. If his current grade level (on a particular problem type) is L and the level of the problem to be averaged in is P, then the averaging formula is simply:

$$L = .9L + .1P$$

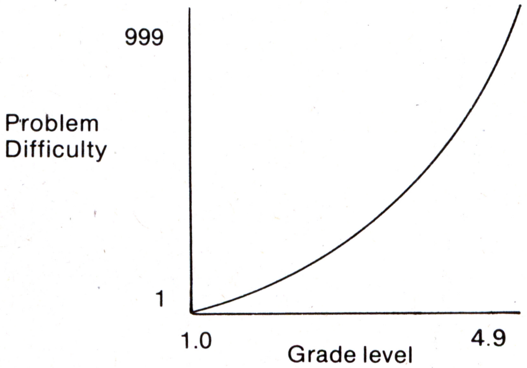
A grade level must be kept for the student for each type of problem that he is doing. So if a student is dealing with 9 different math concepts (or standards), he is assigned a grade level for each one.

Our next task is to assign a grade level to each problem presented. This unfortunately will vary depending upon the local school system, the textbooks used, and teaching method. Since we certainly don't want to store a huge data base of problems tagged with a grade level, for each problem type, we probably should try to devise a simple method of determining its grade level. We must also determine what level should be presented to the student. One straightforward approach is to present problems up to one-half a grade level over and under where the student currently is. Thus the overall range of problems for a student at grade level 3.2 would be 2.7 to 3.7.

How do we generate the right problems? Let's consider one type for now: vertical addition. Say it's first introduced in Grade 1 and continues through Grade 4 (actually 4.9). The simplest problem is 1 + 1 and most difficult 999 + 999. In other words:

Grade Level	*Addend*
1.0	1
4.9	999

Clearly, learning is not a linear process so we can't use a simple linear formula, hence we need something that represents the exponential process of learning.



There are lots of exponential representations like logs, powers, etc. A. fairly trivial, but workable formula for this problem is:

$$\text{Addend} = 1.73 \times \text{Grade Level}^4$$

or

$$\text{Grade level} = \sqrt[4]{\text{Addend}/1.73}$$

To fill in a few more values on our tables:

Grade level	*Addend*
1.0	1
2.0	27
3.0	140
4.0	442
4.9	997

Now it's a relatively straightforward, although somewhat tedious matter, to tie all these elements together in a computer program.

A few notes about the program. G2 is a variable that is within one-half a grade level of the current level of the student, G1. The complicated mess in statement 350 determines a fair approximation of grade level based on the answer to the problem. The recording of the grade level and carrying over to the next lesson is a manual process; grade level could just as easily be retained on a file medium such as floppy disk or cassette tape and keyed to the name or number (heaven forbid) of the student. ■

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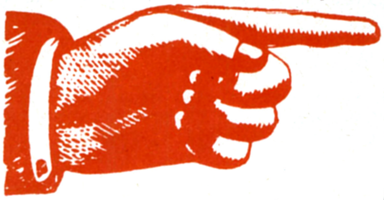

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- **Ron Jones**
  Founder, Zephyros Education Exchange and DeSchool Primers
- **Kenneth Knowlton**
  Computer artist, inventor of EXPLOR graphics language
- **Walter Koetke**
  Pioneer in using computers in secondary school mathematics
- **Peter Kugel**
  Inventor of many logic games
- **Ruth Leavitt**
  Computer artist, author of *Artist and Computer*
- **Sol Libes**
  Author of many electronics texts, President NJ Amateur Computer Group
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Special Music Features
Saga of a System
Algorithmic BASIC
Build a Kluge Harp
Altair S-100 Bus Peripheral Profiles

Here's an unretouched memo from our Publisher to our Editor. You'll find it interesting!

MEMO

To: Steve Gray

From: Dave Ahl

Subj: Editorial direction

The comments from our readership survey and "meet the publisher sessions" at 3 recent conferences indicate that people would like to ~~the~~ see the following stuff in Creative.

First of all, readers are looking to us for applications and software. They want, and we must provide, complete nuts and bolts how-to material. No gee-whiz success stories, but stuff that is complete, thorough, and that can be understood and built by a knowledgeable beginner. I don't want to get into home-brew CPUs, but if an application requires a piece of hardware not commercially available, I want complete schematics and construction details. Same with software -- I'd like to focus on high-level languages, but if it's necessary for an application, we should provide machine code programs or subroutines.

Readers seem to like our diversity; hence we should endeavour to maintain our broad scope in educational and recreational computing. Specific articles that we should shoot to run in the next 12 months include:

1. File catalog and retrival system. Generalized so can be used for books, magazines, LP records and tapes, antiques, coins, household inventory (for insurance), etc. Maybe two versions -- one for cassette, one for floppy.

2. Text editing system(s). One use is for writing and editing letters and reports (both for kids in school and adults). The other use we should hit is for responding to correspondence by using canned letters and paragraphs.

3. Computer assisted instruction. A non-trivial drill and practice/tutorial system with full individualized record-keeping for mathematics and language arts for a fairly small micro.

4. Small business customer records system.

5. Kinetic and/or video art system. Must go beyond TV Dazzler

6. External device interfacing (A/D, D/A, sensors) tutorial.

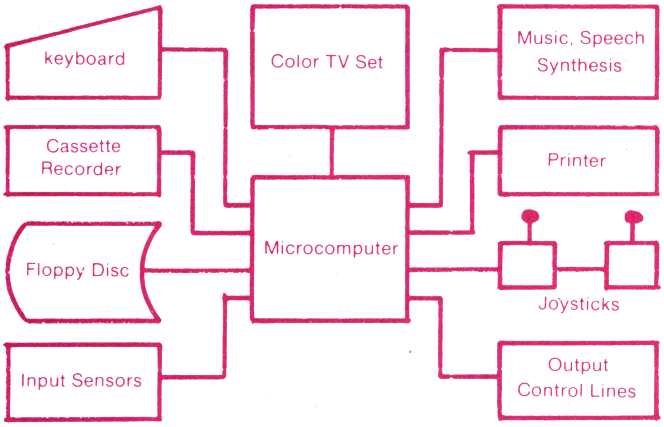
7. A complete series on speech synthesis, speech recognition, and music synthesis.

8. A very thorough product-by-product comparison of all high-level mini and micro software. Let's start with Basic interpreters

I have lots more -- let's get together when I get back next week and map out the next issue in detail. By the way, I just got in some Fabulous new Basic games -- let's talk about possibly running the in optical bar code along with the listings. Till then.

Creative Computing is the number 1 magazine in personal computing software and applications.

The typical home or small business computer system starts with a microcomputer, keyboard, cassette recorder, and TV set. From there you can add the peripherals, sensors, controllers, and other devices you need for your own special applications.



Creative Computing Magazine is dedicated to describing applications for home, school, and small business computers completely and pragmatically in non-technical language. You won't need a Ph.D in Computer Science, or a technical reference library, or a computer technician beside you to get these applications up and running. We give you complete hardware and software details. Typically, applications utilize commercially available systems. However, if an application needs a piece of home-brew hardware, we tell you how to build it. Or if it requires a combination of high-level and machine language code, we give you the entire listings along with the flowcharts and algorithms.

We also run no-nonsense reviews of computers (assembled and kits), peripherals, terminals, software, and books. We're frank and honest, even if it costs us an advertiser, which it occasionally has.

Here are just some of the applications you'll see fully described in future issues of *Creative Computing*.

Building Management and Control

1. Alarm monitoring/police notification
2. Environmental control (heating, air conditioning, humidification, dehumidification, air purity, etc.)
3. Fire and smoke detection
4. Appliance control (microwave oven, gas oven, refrigerator)
5. Perimeter system control (sprinklers, outdoor lights, gates)
6. Solar and/or auxiliary energy source control
7. Watering system control based on soil moisture
8. Fuel economizing systems
9. Maintenance alert system for household devices (key component sensing and periodic preventative maintenance)

Household Management

1. Address/telephone file
2. Investment analysis
3. Loan/annuity/interest calculations and analysis
4. Checkbook maintenance
5. Periodic comparisons of expenditures vs. budget
6. Monitor time and cost of telephone calls
7. Record incoming telephone calls and select appropriate response to caller
8. Recipe file
9. Diet/nutrition analysis
10. Menu planning
11. Pantry inventory/shopping list

Health Care

1. Medical/dental record keeping
2. Insurance claim processing
3. Health maintenance instrumentation control (EKG, blood chemical analysis, diet analysis, self-diagnosis)

Education and Training

1. Mathematics drill and practice
2. Problem solving techniques
3. Tutorial instruction in a given field
4. Simulation and gaming
5. Music instruction and training
6. Music composition and synthesis
7. Learning to program
8. Software development
9. Perception/response/manipulation skills improvement

Recreation and Leisure

1. Games, games, games
2. Puzzle solving
3. Animation/kinetic art
4. Sports simulations
5. Needlepoint/stitchery/weaving pattern generation
6. Computer art
7. Library cataloging (books, records, etc.)
8. Collection catalog/inventory/value (coins, stamps, shells, antique auto parts, comics, etc.)
9. Model railroad control
10. Amateur radio station control
11. Astronomy; star, planet, satellite tracking
12. Robotics
13. Speech recognition and synthesis

Business Functions

1. Small business accounting
2. Word processing/text editing
3. Customer files
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ARTICLES AND COMMENTARY

- **Editorials**

Birth of a Magazine Ahl 2
A Computer in the Classroom? Ahl 3
Is Breaking Into A Timesharing System A Crime? — Tagg 4
Where Are We Going? — Ahl 5

- **Computers in Education**

What's Wrong With the Little Red Schoolhouse? — Ahl 6
How to Cope With Your Computer Most 8
Recent Trends in Mathematics Curriculum Research — Critchfield 9
CITALA Computing in a Two-Year College — Howard, et al 15
EXPER SIM Experimental Simulation Main 18
Monty Python Meets Monte Cristo Taylor 22
IFIP Conference Report — Hebenstreit 23

- **Transportability**

The Parable of the Horse — Nevison 24
Technical Transport Problems — Dunnagan 26
CONDUIT Documentation Guideline 28
Statewide Pools May Not Yield Expected Benefits — Magarrell 30

- **Hard Core CAI**

PLATO IV System Progress McWilliams 31
TICCIT System Progress McWilliams 33
PLANIT The Portable CAI System Frye 35

- **Careers**

A Computer Career for You? — Edwards 37
Career Education Will It Last? Kennedy 42
Key to Your Future? — Corr 43
Profile of an Industry 44

- **Applications**

Computers and the Weather 47
Computer Simulation of the Atmosphere 49
Weather Forecasting Applications 50
Relativity for Computers All Arithmetic 52
Mr Spock's 7th Sense — Kibler 53

- **Programming and Languages**

Structured Programming — Hoogendyk 55
On Computer Languages — Ahl 57
Toward A Human Computer Language — Cannara 58
Learning About Smalltalk — Goldeen 61
Eclectic Programming Languages Ireland, Glick 64
A New Approach to Testing — Hershkowitz 65

- **Computer Impact on Society**

The Computer Threat to Society — Ahl 66
Digital Calculators — Then and Now 68
The Computer Threat to Society? Tunney 72
Putting Teeth Into Privacy Legislation — Hastings 73
Industry Leaders at Privacy Hearings — Hastings 74
Record-keeping in the Space Age — Henderson 75
A Manufacturer Looks at Data Privacy — Fritze 76
Survey of Public Attitudes Toward Computers — Ahl 77
NBS Privacy Conference 80
How Much Privacy Should You Have — Westin 81
Memoirs of an Ex-Social Security Number Giver — Campbell 83
Crime, Cops, Computers — Malcolm 84
Prosecutor Management Information System — Ahl 86
A Computerized Criminal Justice System — Boekelman 87
Embezzler's Guide to the Computer — Allen 88
Credit Card Crooks 89
Waiting for the Great Computer Rip-Off — Hastings 90
Computer Abuse — Snyder 91
Doomsday 100 Years Away — Reinhold 94
Supermarkets Are Going Bananas Over Computers — Barnett 97
Community Memory A Public Information Network 100

- **The Fascinating Computer**

Turning On With Computer Art — Marks 101
New Communications Media — Johansen 103
Computer Cartoons — Anderson 104
Building A Computer of Your Own Gray 107

FICTION AND POETRY

Daddy and His Computer — McWilliams 110
The Life and Times of Multivac — Asimov 111
Time and Again, and Overtime — Weaver 117
Poems by Peter Payack 119

FOOLISHNESS

We're Losing Our War Against Computers — Clarke, Koch 122
Genesis—Release 2.5 — Coleman, Burgess 124
The Fabulous Furry Freak Brothers — Shelton 126
Fractionated People — Henderson 128
Test For System Analysts 130
Span-O-Vision #1 — Johnson 131
Confess A Humanistic Prescriptive Program — Majer, Flanigan 132
The Guiness Book of Computer Records — Yarbrough 134
Trots and Bonnie — Flenniken 135
Draw the Bug From the Computer 136

PEOPLE, PLACES, AND THINGS

Nicholas Copernicus 138
Evelyn Roth 139
PILOT 73 Information Exchange Yob 140
Nolan Bushnell — Todd 140
Playing PONG to Win — Ahl 141
Your Own Computer? — Ahl 142
Introducing Computer Recreations Corp — Todd, Guthrey 142
Creative Computing Compendium Todd 143
Flying Buffalo — Loomis 148
Compleat Computer Catalogue 149
National Computers in Education Conference? 154
Public Access Questionnaire — Press 154
Still A Few Bugs in the System Ahl 155
Computer-Generated Super-8 Movies 156
NSF Awards 157
Hewlett-Packard Computer Curriculum Project 158
Can You Solve the Energy Crisis? Klassen 159
Good Things From Oregon 160
Letters to the Editor 161
T-Shirt Ad 164

PROGRAMS, PUZZLES, PROBLEMS, AND ACTIVITIES

- **Problems for Creative Computing**

Tac Tix and The Complications of Fallibility — Koetke 166
Palindromes — Koetke 168
Computing Factorials—Accurately Koetke 172
Aedi, Mutab, Neda, and Sogal — Koetke 175
Reading, Writing, and Computing — Koetke 178
Probability — Johnson 180
Compounding — Reeves 180
Doubling Up — Tapson 181
Puzzles and Problems for Computers and Humans 182
Pythagorean Triples — Acuna 184
Puzzle People and Cabins 185

- **Activities to Begin With**

Turtle Geometry Without Hardware —McLean, Pagano 186
The 10¢ Computer and Other Games Lyon 189
Beginning With BASIC — Morrison 190
Odd or Even — Moskow 192
Alphabet Statistics 193
Sports Special 194
You Don't Need A Computer For These Ahl 195
Learning, Innovation, and Animals Ahl 196
Computers in the English Curriculum Press 202
Surveys, the Census, and Privacy Ahl 205
Interview — Ahl 208
Life Auction 210
What Do You Value — Richards 211
Fairy Tales Can Come True — Jones 214
You Are A Businessman — Jones 216
Technology—Doomsday for Individualism? — Jones 218

- **More Advanced Activities**

Escape — Harris 220
The Automobile and Air Pollution — Peckham 223
Computer Experiments in Cognitive Psychology — Bewley 228
The Journalism Programs — Bishop 234
Shorthand Instruction Via Computer — Kavan, Gallion 237
A Universal Word Game in BASIC Milstein 239
Dynamic Modelling Using Fortran IV — Anderson 241

COMPUTER GAMES

Call for Games 246
Hunt the Wumpus — Yob 247
Depth Charge — Noftle 251
NOTONE — Puopolo 253
Civil War — Cram, Goodie, Hibbard 254
Guess 257
Reverse — Sessions 258
Schmoo — Bell 259
Binary — Park 261
Seawar — Paxton, Dobbs 262
Lunar Landing — Ahl 264
Love — Ahl 265
Geowar — Janowiak, Yob 266
Splat Parachute Jump — Yegge 268
ICBM — Calter 269
Rabbit Chase — Park 270
Magic Square — Ahl 271
MADLIB — Gallo, Ahl 272
Super Star Trek — Leedom, Ahl 275

REVIEWS

- **Creative Computing Library Ad** 284

- **Book and Game Reviews**

Education and Ecstasy, Leonard 285
Man and the Computer, Kemeny 287
Survival Printout, Total Effect 287
Equations, Instructional Math Play, On Words, Allen, et al 288
On Sets, Allen et al 288
Space Hop, Wimmer 288
BASIC in a Flash, Orf & Helmbrecht 288
II Cybernetic Frontiers, Brand 289
The Use and Misuse of Computers in Education, Ellis 289
Computers in the Classroom, Margolin & Misch 289
Learning for Tomorrow, Toffler 289
Electric Media, Brown & Marks 290
Computers and Young Children 290
Computer Poems, Bailey 290
Background Math for a Computer World, Ashley 290
Computers, Srivastava 290
The Electronic Brain How it Works, Cook 290
Six Books on Computer Literacy 291
Computers Tools for Today, DeRossi 291
Computers and Society, Rothman & Mossman 292
Getting Started in Classroom Computing, Ahl 292
Computers and You, Stehling 293
CAI Project Report, Dunn & Wastler 293
Snobol An Introduction, Newstead 293
Business Data Processing I, Albrecht 293
How to Survive in Your Native Land, Herndon 294
The Digital Villain, Baer 294
Databanks in a Free Society, Westin & Baker 294
The Terminal Man, Crichton 294
The Electronic Criminals, Farr 294
Freedom's Edge, Wessel 295
Zen and the Art of Motorcycle Maintenance, Pirsig 295
The Eco-Spasm Report, Toffler 296
Computers in Society, Spencer 296
Principles of Systems, Forrester 296
World Dynamics, Forrester 296
- **Review of 34 Books on BASIC** Gray 298

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ARTICLES AND COMMENTARY

•Technology — Present and Future

The Future of Computer Technology - *Dragunas* 2
Computing Power to the People - *Chen* 3
Videodiscs — The Ultimate Computer Input Device? - *Bork* 7
Round and Round They Go 9
The $2.98 Computer Library - *Luehrmann* 10
Personal Computers 11
Russian Computing - *Ahl* 12
Desk Calculator from China - *Chang* 14
Microprocessors & Microcomputers — The State of the Art - *Callahan* 15

•Languages and Programming Theory

The Reactive Engine Paper - *Winograd* 18
About Computing - *Chase* 20
David vs. 12 Goliaths - *Newborn* 21
Sixth Chess Championship Summary - *Newborn* 22
Beating the Game - *Thomsen* 23
Simulated Strategies of Game Playing - *Reisman* 25
Beyond BASIC - *Salisbury* 26
The Computer "Glass Box" Teaching with APL - *Peelle* 30
Creative Chess - *Koetke* 34
SNOBOL - *Touretzky* 36
A Smalltalk Airplane Simulation - *Horn* 37

•Artificial and Extraterrestrial Intelligence

Non-Human Intelligence - *Ahl* 39
An Esoteric Ethical Excursion - *Lees* 40
The Thinking Computer - *Raphael* 42
Primer on Artificial Intelligence - *Garrett* 46
Can Computers Think - *Ahl* 151
An Ear on the Universe - *Lees* 53
Communication Across the Universe - *Harwit* 57
The Cosmic Subway Line - *Asimov* 59

•Literacy, Philosophy, Opinion

What is Computer Literacy - *Moursund* 61
Computer Literacy Quiz - *Moursund* 62
A Fable - *Spero* 63
Let Us First Make It - *Taylor* 64
Some Thoughts - *Lees* 66
Information Anyone? - *Griffith* 68
The Government Dinosaur - *Winn* 70
The Magic of EFTS - *Ahl* 72

•Computers in Education

Instructional Computing in Schools - *Ahl* 73
Should the Computer Teach the Student, or Vice-versa? - *Luehrmann* 74
The Art of Education: Blueprint for a Renaissance - *Dwyer* 78
Computing at the University of Texas 82
Computers in Secondary Schools - 1975 83
Compyouter Fair - *Thomas* 84
The Madness known as Programming Contests - *Lees* 86
Calculators in the Classroom - *Pendleton* 88

•Every Person and the Computer

Amateur Computing - *Libes* 90
A Retail Computer Store? You Gotta Be Kidding - *Dunion and Roberts* 91
Grand Opening - *Cary* 94
Polls, Pols, and Power: The Computer on the Hustings - *Acocella* 97
An Analytic Examination of Creative Computing - *Ahl* 100
How We Spent Our Summer Vacation - *Lees, et al* 101

•Art and Poetry

Toward the Electric Symbol - *Mueller* 105
Producing Computer Poetry - *Chisman* 105
Interview with Carole McCauley - *Silverstein* 108
Once Upon a Computer . . . - *McCauley* 109
Computers and Beauty - *Sasaki and Sasaki* 112

FICTION AND POETRY

A Day in the Life of Able Charlie - *Pohl* 118
A Place for Today - *Vitale* 121
Pulling the Plug - *Mosmann* 123
Poems - *Payack* 125
Never Talk to Computers That Are Strange - *Cail* 126
Terminal Illness - *Glick* 130
Report on Current Equipment 132
Computers Don't Argue - *Dickson* 133
Star-Times Gazette - *Dragunas* 138
Poems - *Gloe* 139
Ode To A School Computer - *Ahl* 140

FOOLISHNESS

Little REM Writing Loop - *Hadley* 142
The Sleeping Queued T - *Ludwig* 144
Conceptual Chess - *Johnson* 146
Trots and Bonnie - *Flenniken* 147
Quite-A-Tot - *Beker* 148
A Brief Guide to the Theory of Relativity - *Payack* 150
Span-O-Vision - *Johnson* 151

RESOURCES AND RELATED

Compleat Computer Catalogue 154
Star Trek Information Exchange 162
Altair Convention 164
Compendium 165
Input/Output 169

PUZZLES, PROBLEMS, AND PROGRAMS

•Puzzles and Problems

Puzzles, Puzzles, Puzzles - *Ahl* 174
Thinkers' Corners, Recreations 190
Turning A Puzzle Into A Lesson - *Homer* 194

•For The Calculator

The Keyboard Game - *Yarbrough* 196
7 Pocket Calculator Games - *Rogers* 198
Calculator Tricks 206

•Mathematics and Geometry

The Mystic Seven - *Dickens* 199
Magic Squares on the Computer - *Piele* 200
Non-Usual Mathematics - *Reagan* 207
The World of Series - *Reagan* 208
Change For A Dollar - *Hess* 209
Sequences - *Jessen* 210
Progression Problems - *Reeves* 211
Seeing is Believing but Simulating is Convincing - *Koetke* 212
Computer Generated Aids to Teaching Geometric Concepts - *Barnes and Stocker* 213
Geometric Proofs - *Kelanic* 219
Computer Planned Snowmen - *McLean* 221
The Tower of Brahma 222

•Non-Mathematical Applications

Roses Are Red, Computers Are Blue - *Ahl* 223
Haiku Generator - *Emmerich* 226
Prejudice Analysis - *Kahn and Gross* 228
A Prejudiced Analysis - *McCarthy* 229
CMAPS: A Basic Program for Choropleth Mapping - *Cerny* 230

•Programming Techniques

Heapsort - *Chase* 233
A Comparison of Sorts - *Grillo* 234
Days and Dates - *Reagan* 238
Conditional Statements, Searching A List 240

COMPUTER GAMES

Learning with Computer Games - *Ahl* 242
Wumpus 2 - *Yob* 244
War 3 - *Forman* 247
Dr. Z 247
Roadrace - *Cotter* 250
Concentration - *Calter* 252
Condot 253
Chase - *Cotter* 253
Mastermind - *Struble* 256
Deepspace - *Cotter* 258
Bobstones - *Addleman* 260
Watchman - *Oglesby* 262
Delman - *Morgan and Roderick* 264
Poster - *Huntress* 266
LEM - *Cotter* 268
Two-to-Ten 270

HARDWARE

Building a MITS Altair 8800 First Impressions - *Gray* 272
Getting a System Together - *Kuzmack* 275
Odyssey Video Games - *Ahl* 278
HP-25 Calculator - *Blodgett* 279
Buying a Used Teletype - *Ahl* 280
HP 9815A Calculator - *Ettel* 281
Tektronix 4051 - *Gray* 282
Disk Destruction Made Simple - *Thorne* 284

REVIEWS

†34 Books on BASIC - *Gray* 286
ANS Cobol - *Ashley* 297
†Computer Power and Human Reason - *Weizenbaum* 298
Computers and Creativity - *McCauley* 306
Computer Lib/Dream Machines - *Nelson* 307
The Compleat Computer - *Van Tassel* 307
The Elementary Functions - *Higgins* 307
†Artificial Intelligence - *Minsky & Papert* 308
†The Psychology of Computer Vision - *Winston* 308
Recursive Programming Techniques - *Burge* 311
Intelligent Life in the University - *Shklovskii and Sagan* 311
The Cosmic Connection - *Sagan* 311
Artificial Intelligence - *Hunt* 312
On Machine Intelligence - *Michie* 312
The Sun Never Sets on IBM - *Foy* 312
Applications of Computer Systems - *Bassler and Joslin* 313
The Assault on Privacy - *Miller* 313
The Moon Is A Harsh Mistress - *Heinlein* 313
The Listeners - *Gunn* 313
Introduction to Data Processing - *Harris* 314
Fun and Games With the Computer - *Sage* 314
101 BASIC Computer Games - *Ahl* 314
Understanding Math and Logic Using Computer Games - *Ahl* 314
What To Do After You Hit Return 314
Game Playing with Computers - *Spencer* 315
Games, Tricks and Puzzles for a Hand Calculator - *Judd* 315
Games Calculators Play - *Seymour* 315
Mathematical Carnival - *Gardner* 315
The Computerized Society - *Martin and Norman* 315
Simulation Games in Learning - *Boocock and Sehild* 316
Math, Writing & Games in the Open Classroom - *Kohl* 316
Getting the Most Out of Your Electronic Calculator - *Hunter* 316
Problems for Computers Solution - *Gruenberger and Jaffray* 317
Primer in Computer Utilization - *Curtis and Erickson* 317
Computer Algorithms and Flowcharting - *Silver and Silver* 317
Mathematics, A Human Endeavor - *Jacobs* 317
Mathematics In The Modern World 317
†Learning Alternatives in U.S. Education - *Hunter, et al* 318
Edcentric 319
Security, Accuracy, and Privacy in Computer Systems - *Martin* 319
Scelbi's Galaxy Game - *Findley* 319
Scelbi's First Book of Computer Games - *Wadsworth and Findley* 319
Sorting and Sort Systems - *Lorin* 320
Mechanics - *Peckham* 320
User's Guide to Computer Crime - *Leibholz and Wilson* 320
Electronic Computers - *Hollingdale and Tootill* 321
Configurations - *Dorwart* 321
Software Tools *Kernighan and Plauger* 321
TTL Cookbook - *McLean* 322
Queries 'N Theories - *Allen, Kugel & Ross* 322
†Space 1999 (TV Show) - *Glick* 323

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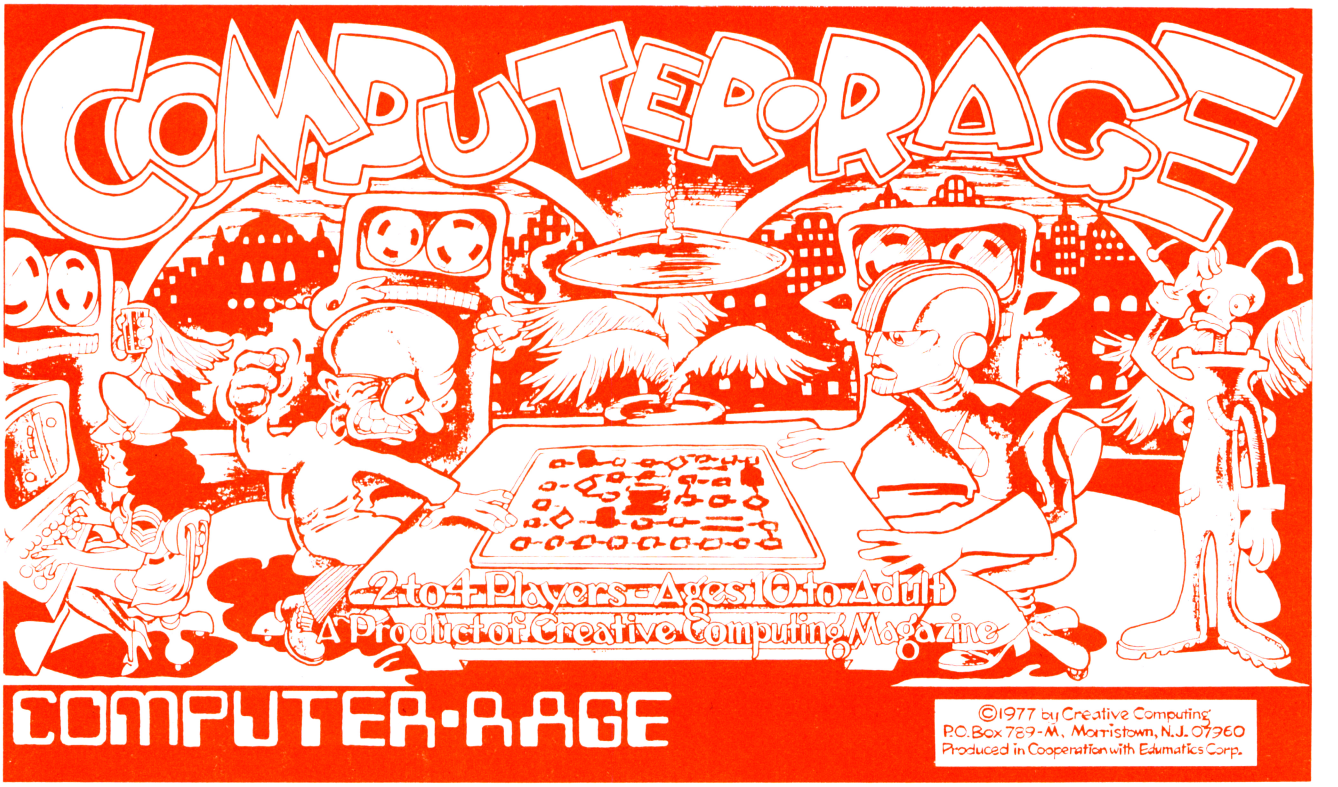
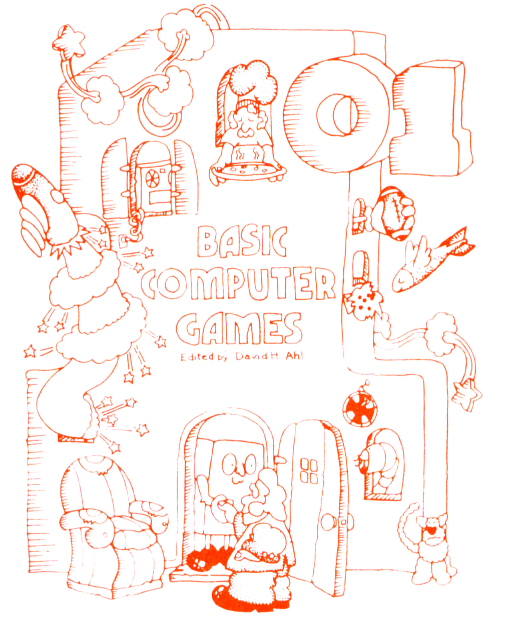

COMPUTER-RAGE
2 to 4 Players - Ages 10 to Adult
A Product of Creative Computing Magazine
COMPUTER-RAGE
©1977 by Creative Computing
P.O. Box 789-M, Morristown, N.J. 07960
Produced in Cooperation with Edumatics Corp.

COMPUTER RAGE is a fascinating new board game based on a large-scale multi-processing computer system. The object is to move your three programs from input to output. Moves are determined by the roll of 3 binary dice. Hazards include priority interrupts, program bugs, decision symbols which alter your path, power failures, and restricted use input and output channels. Notes are included for using the game in school. Ages 10-adult; 2-4 players. **COMPUTER RAGE** comes with a colorful board, 12 program playing pieces, 3 binary dice, 38 interrupt cards. Orders must be prepaid. Only $8.95 postpaid ($10 outside of USA). Creative Computing, P.O. Box 789-M, Morristown, NJ 07960, Attn: Darcy.



101 BASIC Computer Games is the most popular book of computer games in the world. Every program in the book has been thoroughly tested and appears with a complete listing, sample run, and descriptive write-up. All you need add is a BASIC-speaking computer and you're set to go.

101 BASIC Computer Games. Edited by David H. Ahl. 248 pages. 8½x11 paperbound. $7.50

Contents

Game	Brief Description
ACEYDU	Play acey-ducey with the computer
AMAZIN	Computer constructs a maze
ANIMAL	Computer guesses animals and learns new ones from you
AWARI	Ancient game of rotating beans in pits
BAGLES	Guess a mystery 3-digit number by logic
BANNER	Prints any message on a large banner
BASBAL	Baseball game
BASKET	Basketball game
BATNUM	Match wits in a battle of numbers vs the computer
BATTLE	Decode a matrix to locate enemy battleship
BINGO	Computer prints your card and calls the numbers
BLKJAC	Blackjack (very comprehensive), Las Vegas rules
BLKJAK	Blackjack (standard game)
BOAT	Destroy a gunboat from your submarine
BOMBER	Fly World War II bombing missions
BOUNCE	Plot a bouncing ball
BOWL	Bowling at the neighborhood lanes
BOXING	3-round Olympic boxing match
BUG	Roll dice vs. the computer to draw a bug
BULCOW	Guess a mystery 5-digit number vs the computer
BULEYE	Throw darts
BULL	You're the matador in a championship bullfight
BUNNY	Computer drawing of the Playboy bunny
BUZZWD	Compose your speeches with the latest buzzwords
CALNDR	Calendar for any year
CAN-AM	Drive a Group 7 car in a Can-Am road race
CHANGE	Computer imitates a cashier
CHECKR	Game of checkers
CHEMST	Dilute kryptocyanic acid to make it harmless
CHIEF	Silly arithmetic drill
CHOMP	Eat a cookie avoiding the poison piece (2 or more players)
CIVILW	Fight the Civil War
CRAPS	Play craps (dice), Las Vegas style
CUBE	Negotiate a 3-D cube avoiding hidden landmines
DIAMND	Prints 1-page diamond patterns
DICE	Summarizes dice rolls
DIGITS	Computer tries to guess digits you select at random
DOGS	Penny arcade dog race
EVEN	Take objects from a pile – try to end with an even number
EVEN1	Same as EVEN – computer improves its play
FIPFOP	Solitaire logic game – change a row of Xs to 0s
FOOTBL	Professional football (very comprehensive)
FOTBAL	High School football
FURS	Trade furs with the white man
GOLF	Golf game – choose your clubs and swing
GOMOKO	Ancient board game of logic and strategy
GUESS	Guess a mystery number – computer gives you clues
GUNNER	Fire a cannon at a stationary target
GUNER1	Fire a cannon at a moving target
HANG	Hangman word guessing game
HELLO	Computer becomes your friendly psychiatrist
HEX	Hexapawn game
HI-LO	Try to hit the mystery jackpot
HI-Q	Try to remove all the pegs from a board
HMRABI	Govern the ancient city-state of Sumeria
HOCKEY	Ice Hockey vs. Cornell
HORSES	Off-track betting on a horse race
HURKLE	Find the Hurkle hiding on a 10 x 10 grid
KINEMA	Drill in simple kinematics
KING	Govern a modern island kingdom wisely
LETTER	Guess a mystery letter – computer gives you clues
LIFE	John Conway's Game of Life
LIFE-2	Competitive game of life (2 or more players)
LITQZ	Children's literature quiz
MATHD1	Children's arithmetic drill using pictures of dice
MNOPLY	Monopoly for 2 players
MUGWMP	Locate 4 Mugwumps hiding on a 10 x 10 grid
NICOMA	Computer guesses number you think of
NIM	Chinese game of Nim
NUMBER	Silly number matching game
1CHECK	Challenging game to remove checkers from a board
ORBIT	Destroy an orbiting germ-laiden enemy spaceship
PIZZA	Deliver pizzas successfully
POETRY	Computer composes poetry in 4-part harmony
POET	Computer composes random poetry
POKER	Poker game
QUBIC	3-dimensional tic-tac-toe
QUEEN	Move a single chess queen vs. the computer
REVRSE	Order a series of numbers by reversing
ROCKET	Land an Apollo capsule on the moon
ROCKT1	Lunar landing from 500 feet (with plot)
ROCKT2	Very comprehensive lunar landing
ROCKSP	Game of rock, scissors, paper
ROULET	European roulette table
RUSROU	Russian roulette
SALVO	Destroy an enemy fleet of ships
SALVO1	Destroy 4 enemy outposts
SLOTS	Slot machine (one-arm bandit)
SNOOPY	Pictures of Snoopy
SPACWR	Comprehensive game of spacewar
SPLAT	Open a parachute at the last possible moment
STARS	Guess a mystery number – stars give you clues
STOCK	Stock market simulation
SYNONM	Word synonym drill
TARGET	Destroy a target in 3-D space – very tricky
3D PLOT	Plots families of curves – looks 3-dimensional
TICTAC	Tic-tac-toe
TOWER	Towers of Hanoi puzzle
TRAIN	Time-speed-distance quiz
TRAP	Trap a mystery number – computer gives you clues
23MTCH	Game of 23 matches – try not to take the last one
UGLY	Silly profile plot of an ugly woman
WAR	Card game of war
WAR-2	Troop tactics in war
WEKDAY	Facts about your birthday
WORD	Word guessing game
YAHTZE	Dice game of Yahtzee
ZOOP	BASIC programmer's nightmare

THE BEST OF BYTE — VOL. 1

The Best of Byte - Volume 1 is a 384-page blockbuster of a book which contains the majority of material from the first 12 issues of *Byte* magazine. 146 pages are devoted to "Hardware" and are cram full of how-to articles on everything from TV displays to joysticks to cassette interfaces. The section on computer kits describes building 7 major kits. But hardware without software might as well be a boat anchor, so there are 125 pages of "Software and Applications" ranging from on-line debuggers to games to a complete small business accounting system. A section on "Theory" examines the how and why behind the circuits and programs, and a final section "Opinion" looks at where this explosive new hobby is heading.

The Best of Byte - Volume 1 is edited by Carl Helmers and David Ahl and published by Creative Computing Press. Price in the US is $11.95 plus $1.00 shipping and handling ($12.95 total); foreign orders add $1.00 ($13.95 total). Orders from individuals must be prepaid. Creative Computing Press, Dept. CC-14, P.O. Box 789-M, Morristown, NJ 07960. Allow 8 weeks for delivery.

OPINION

The Shadow, Buck Rogers, and the Home Computer — *Gardner* 2
The State of the Art — *Helmers* 5
Could a Computer Take Over — *Rush* 8

THEORY AND TECHNOLOGY

A Systems Approach to a Personal Microprocessor — *Suding* 14
Frankenstein Emulation — *Murray* 17
Programming for the Beginner — *Herman* 22
What is a Character — *Peshka* 27
Friends, Humans, and Countryrobots: Lend me your Ears — *Rice* 36
Magnetic Recording for Computers — *Manly* 44

COMPUTER KITS

Assembling an Altair 8800 — *Zarrella* 56
Build a 6800 System With This Kit — *Kay* 59
More on the SWTPC 6800 System — *Kay* 64
The New Altair 680 — *Vice* 68
A Date With KIM — *Simpson* 72
True Confessions: How I Relate to KIM — *Gupta* 76
Zilog Z80 — *Hashizume* 81
The Digital Equipment LSI-11 — *Baker* 86
Cromemco TV Dazzler 94

HARDWARE

Flip Flops Exposed — *Browning* 98
Recycling Used ICs — *Mikkelsen* 102
Powerless IC Test Clip — *Errico and Baker* 104
Parallel Output Interfaces in Memory Address Space — *Helmers* 106
Son of Motorola — *Fylstra* 110
Data Paths — *Liming* 117
Build a TTL Pulse Catcher — *Walde* 124
Dressing Up Front Panels — *Walters* 125
Deciphering Mystery Keyboards — *Helmers* 126
A Quick Test of Keyboards — *Walters* 134
Keyboard Modification — *Macomber* 135
Serialize Those Bits From Your Mystery Keyboard — *Halber* 136
Build a Television Display — *Gantt* 138
The "Ignorance Is Bliss" Television Drive Circuit — *Barbier* 144
Build a TV Readout Device for Your Microprocessor — *Suding* 145
Let There Be Light Pens — *Loomis* 153
Build an Oscilloscope Graphics Interface — *Hogenson* 158
An Introduction to Addressing Methods — *Zarrella* 169
Interface an ASCII Keyboard to a 60mA TTY Loop — *Cotton* 174
Interfacing the 60 mA Current Loop — *King* 175
The Complete Tape Cassette Interface — *Hemenway* 177
Digital Data on Cassette Recorders — *Mauch* 184
Build a Fast Cassette Interface — *Suding* 190
Technology Update 197
What's In a Video Display Terminal? — *Walters* 198
Pot Position Digitizing Idea — *Schulein* 199
Read Only Memories in Microcomputer Memory Address Space — *Eichbauer* 200
More Information on PROMs — *Smith* 203
Getting Input from Joysticks and Slide Pots — *Helmers* 210
Logic Probes — Hardware Bug Chasers — *Burr* 213
Controlling External Devices With Hobbyist Computers — *Bosen* 218
Microprocessor Based Analog/Digital Conversion — *Frank* 222
Add a Kluge Harp to Your Computer — *Helmers* 226
The Time Has Come to Talk — *Atmar* 231
Make Your Own Printed Circuits — *Hogenson* 238

SOFTWARE

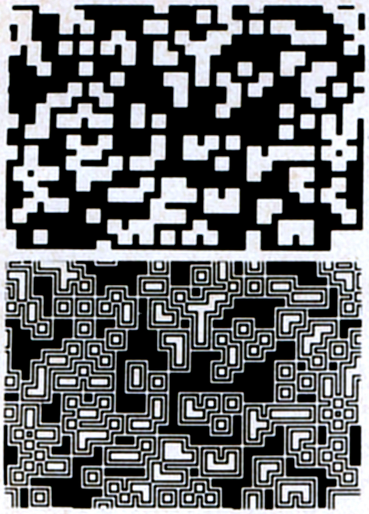
Write Your Own Assembler — *Fylstra* 246
Simplify Your Homemade Assembler — *Jewell* 255
Interact With an ELM — *Gable* 261
Design an On Line Debugger — *Wier and Brown* 268
Processing Algebraic Expressions — *Maurer* 275
The "My Dear Aunt Sally Algorithm" — *Grappel* 286
Can YOUR Computer Tell Time? — *Hogenson* 294
A Plot Is Incomplete Without Characters — *Lerseth* 300
Hexpawn: A Beginning Project in Artificial Intelligence — *Wier* 309
Shooting Stars — *Nico* 314
Biorythm for Computers — *Fox* 322
Life Line — *Helmers* 326

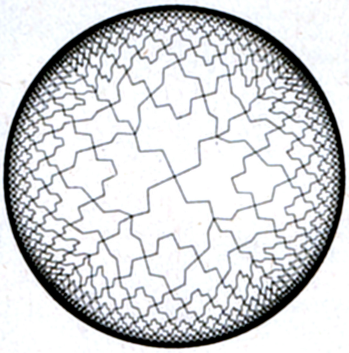
APPLICATIONS

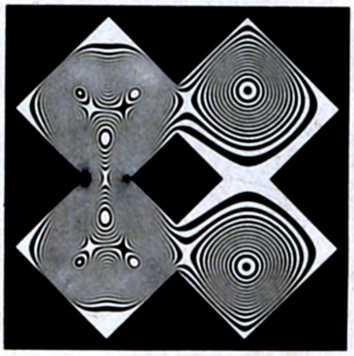
Total Kitchen Information System — *Lau* 360
A Small Business Accounting System — *Lehman* 364
Chips Found Floating Down Silicon Slough — *Trumbull* 369

RESOURCES

Books of Interest 372
Magazines 375





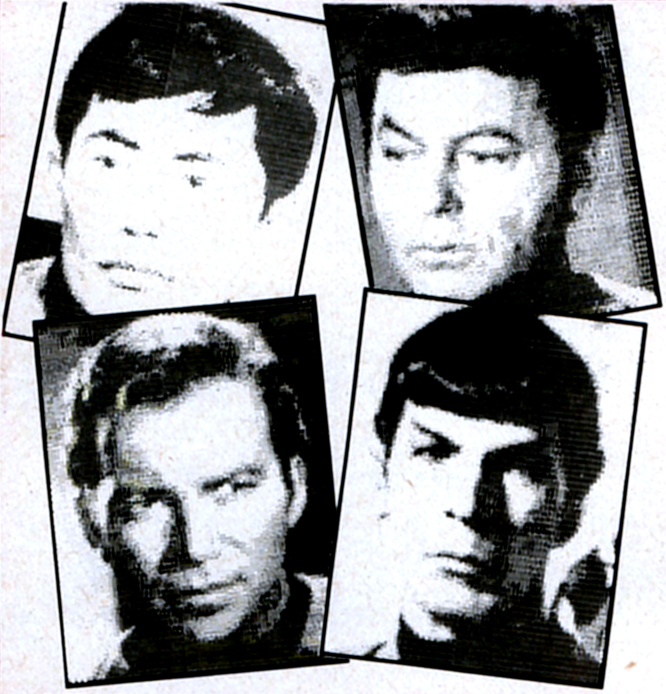


ARTIST AND COMPUTER is a unique new art book that covers a multitude of computer uses and the very latest techniques. In its pages, 35 artists who work with computers explain how the computer can be programmed either to actualize the artist's concept (such as the visualization of fabric before it is woven) or to produce finished pieces. Illustrated with more than 160 examples of computer art, 9 of them in full color, ARTIST AND COMPUTER will fascinate and inspire anyone who is interested in art or computer technology. Size 8½" x 11".

ARTIST AND COMPUTER

Edited by RUTH LEAVITT

132 pages, soft cover $4.95
Cloth cover $10.00



STAR TREK COMPUTER IMAGES

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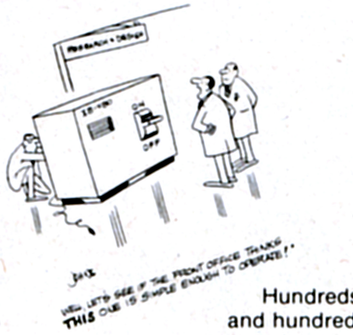
Set of 7 Computer Images. Kirk, Spock, McCoy, Sulu, Scott, Uhrura, and the Enterprise. On heavy poster stock. 8½ x 11. $1.50 per set postpaid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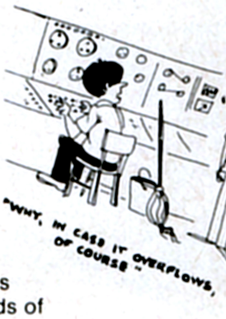
WELL, LET'S SEE IF THE FRONT OFFICE THINKS THIS ONE IS SIMPLE ENOUGH TO OPERATE!"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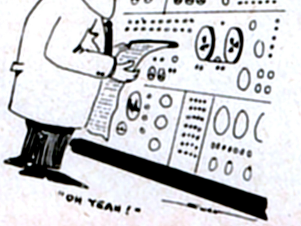
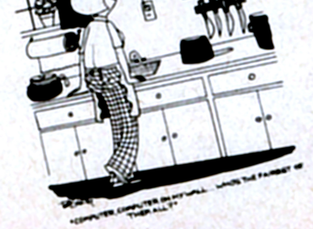



"COMPUTER, COMPUTER ON MY WALL... WHO'S THE FAIREST OF THEM ALL?"

BOOKS BOOKS

Computer Games

101 Basic Computer Games

David H. Ahl. An anthology of games and simulations—from Acey-Deucey to Yahtzee, all in the BASIC language. Contains a complete listing, sample run, plus a descriptive write-up of each game. Our most popular book! Large format, 248 pp. $7.50 [6C]

What to Do After You Hit Return

Another collection of games and simulations—all in BASIC—including number guessing games, word games, hide-and-seek games, pattern games, board games, business and social science simulations and science fiction games. Large format. 158 pp. $8.00 [8A]

Games & Puzzles Magazine

The only magazine in the world devoted to games and puzzles of every kind — mathematical, problematical, crosswords, chess, gomoko, checkers, backgammon, wargames, card games, board games, reviews, competitions, and more. Monthly. 1-Year sub'n $12.00 [3A]

The Star Trek Star Fleet Technical Manual

Franz Joseph. This important resource book is packed with the data you need to create or modify STAR TREK computer games (see 2 above), including all Starship operating characteristics, and defense and weapon systems; standard orbits; velocity/time relationship; space/warp technology; Milky Way galaxy charts; Federation charts; Federation codes; etc., etc. A national best seller. Large format, vinyl binder. 180 pp. $6.95 [8C]

Fun & Games with the Computer

Ted Sage. "This book is designed as a text for a one-semester course in computer programming using the BASIC language. The programs used as illustrations and exercises are games rather than mathematical algorithms, in order to make the book appealing and accessible to more students. The text is well written, with many excellent sample programs. Highly recommended." —*The Mathematics Teacher* 351 pp. $6.95 [8B]

GAME PLAYING WITH COMPUTERS
BY DONALD D. SPENCER

Game Playing With the Computer, 2nd Ed.

Donald Spencer. Over 70 games, puzzles, and mathematical recreations for the computer. Over 25 games in BASIC and FORTRAN are included complete with descriptions, flowcharts, and output. Also includes a fascinating account of the history of game-playing machines, right up to today's computer war games. Lots of "how-to" information for applying mathematical concepts to writing your own games. 320 pp. 1976 $16.95 [8S]

Hand Calculators

Games, Tricks and Puzzles For A Hand Calculator

Wally Judd. This book is a necessity for anyone who owns or intends to buy a hand calculator, from the most sophisticated (the HP65, for example) to the basic "four banger." 110 pp. $2.95 [8D]

All 3 New!

Games With The Pocket Calculator

Sivasailam Thiagarajan and Harold Stolovitch. A big step beyond tricks and puzzles with the hand calculator, the two dozen games of chance and strategy in this clever new book involve two or more players in conflict and competition. A single inexpensive four-banger is all you need to play. Large format. 50 pp. $2.00 [8H]

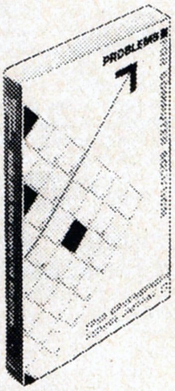
Advanced Applications for Pocket Calculators

Jack Gilbert. Emphasizes new and unique applications that go way beyond manufacturer instruction manuals. Shows how to do scientific calculations with a basic 4-banger. Also covers scientific, programmable and advanced business calculators. Hundreds of examples and tables. 304 pp. 1975 $5.95 [8G]

Problem Solving

How to Solve Problems

Wayne Wickelgren. This helpful book analyzes and systematizes some of the basic methods of solving mathematical problems. Illustrative examples include chess problems, logical puzzles, railroad switching problems and ones from science and engineering. For each, the author provides hints for the reader to tackle the problem, and then a complete solution is given. Want to solve a complex problem with a computer? Begin here. 1974. 262 pp. $6.50 [7Y].



Problems For Computer Solution

Gruenberger & Jaffray. A collection of 92 problems in engineering, business, social science and mathematics. The problems are presented in depth and cover a wide range of difficulty. Oriented to Fortran but good for any language. A classic. 401 pp. $8.95 [7A]

Problem Solving With The Computer

Ted Sage. This text is designed to be used in a one-semester course in computer programming. It teaches BASIC in the context of the traditional high school mathematics curriculum. There are 40 carefully graded problems dealing with many of the more familiar topics of algebra and geometry. Probably the most widely adopted computer text. 244 pp. $6.95 [8J]

LOOK!

Problem Solving: The Computer Approach

LaFave, Milbrandt, and Garth. Describes the process of thinking through the steps needed to solve a problem, flowcharting the steps, coding in a computer language, development of appropriate test data, and manual checking. 176 pp. 1973 $11.65 [8U]

Prices subject to change without notice.

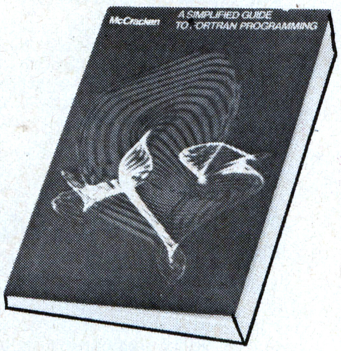
Programming

A Guided Tour of Computer Programming In Basic

Tom Dwyer and Michael Kaufman. "This is a fine book, mainly for young people, but of value for everyone, full of detail, many examples (including programs for hotel and airline reservations systems, and payroll), with much thought having been given to the use of graphics in teaching. This is the best of the introductory texts on BASIC." *Creative Computing* Large format. 156 pp. $4.80 [8L]

Computer Algorithms and Flowcharting

G. Silver and J. Silver. A straightforward approach to analyzing problems and structuring solutions suitable for the computer. Branching, counters, loops, and other important concepts are presented in easily-grasped modular units in the text. 176 pp. 1975 $8.95[8W]



A Simplified Guide to Fortran Programming

Daniel McCracken. A thorough first text in Fortran. Covers all basic statements and quickly gets into case studies ranging from simple (printing columns) to challenging (craps games simulation). 278 pp. $8.75 [7F]

Instant BASIC

Jerald Brown. A self-teaching guide to BASIC for the beginners. Designed to be used with a personal microcomputer running Altair BASIC or a terminal running DEC BASIC-PLUS. Self-tests, practical demonstrations, and practice problems assure fast effective learning. Large format. 1977. $6.00 [7L]

NEW!

The Art of Computer Programming

Donald Knuth. The purpose of this series is to provide a unified, readable, and theoretically sound summary of the present knowledge concerning computer programming techniques, together with their historical development. For the sake of clarity, many carefully checked computer procedures are expressed both in formal and informal language. A classic series. Vol. 1: Fundamental Algorithms, 634 pp. $20.95 [7R]. Vol. 2: Seminumerical Algorithms, 624 pp. $20.95 [7S]. Vol. 3: Sorting and Searching, 722 pp. $20.95 [7T].

NEW!

Computer Science
A First Course
Forsythe Keenan Organick Stenberg

Computer Science: A First Course, 2nd Ed.

A.I. Forsythe, T.A. Keenan, E.I. Organick and *W. Stenberg.* An improved version of an extremely complete and well-prepared volume, this is ideal for self-study or daily reference on the job. Covering all topics in greater depth — and, of course, now providing more up-to-date information — it gives you the material you need on algorithms, data structures, programming, and computer architecture.

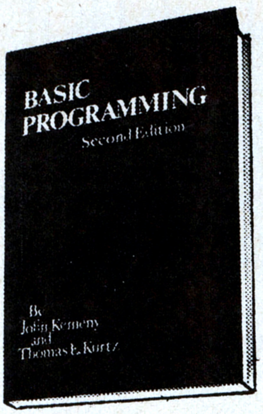
In addition, you'll discover extensions and applications of basic concepts in special areas. Further help is provided by the numerous tables, flowcharts, and data structure diagrams, plus a common base flowchart language for use in top-down structured programming and adaptable to a wide variety of problem application areas. 880 pp. (1975) $16.95 [7D]

My Computer Likes Me

This entertaining self-teaching workbook introduces the BASIC language to young or old. Problems and examples are drawn from population problems and demographic data. A nice, easy start into BASIC. Large format, 60 pp, 1973. $2.00 [8K]

Some Common BASIC Programs

Adam Osborne. An ideal workbook to accompany an elementary BASIC programming course. Contains 76 general purpose practical BASIC programs. The listings are extensively commented. A restricted subset of BASIC was used to insure maximum transferability. 1977. $7.50 [7M]



BASIC Programming 2nd Ed

Kemeny and Kurtz. "A simple gradual introduction to computer programming and time-sharing systems. The best text on BASIC on almost all counts. Rating: A+" - *Creative Computing.* 150 pp. $8.50 [7E]

Programming Proverbs

Henry Ledgard. Features 26 ingenious proverbs to strengthen your powers of program organization and logical thinking. Complete explanation of each proverb including examples of its use or lack of it. Guaranteed improvement of your programming clarity, accuracy, and style. 144 pp. 1975. $6.50 Please specify sample programs in FORTRAN [8Y]. Sample programs in PL/1, ALGOL and other languages [8X].

BASIC

Albrecht, Finkel, and Brown. A self-teaching guide to BASIC written in an informal, easy-going manner. Every difficult point is explained in great detail. 324 pp. $4.95 [7G]

ANS COBOL
Ruth Ashley

ANS COBOL

Ruth Ashley. An excellent self-teaching book for people without previous programming experience and with no access to a terminal. The author anticipates common errors of first-time COBOL users and gives extra help to readers through these parts. 242 pp. $4.95 [7H]

The Calculus With Analytic Geometry Handbook

Jason Taylor. Ideal for a HS or college introductory calculus course or for self-learning. Five chapters include: analytic geometry; functions and derivatives; integration techniques; vectors and functions of more than one variable; and sequences and series. Widely acclaimed by educators, this book is fast becoming the *standard calculus reference text.* Handy reference for scientists, engineers, and mathematicians too. Large format, 68 pp. 1976. $2.95 [7Q]

Building Your Own

Understanding Solid State Electronics

An excellent tutorial introduction to transistor and diode circuitry. Used at the TI Learning Center, this book was written for the person who needs to understand electronics but can't devote years to the study. 242 pp. $2.95 [9A]

Microprocessors

A collection of articles from *Electronics* magazine. The book is in three parts: device technology; designing with microprocessors; and applications. 160 pp. 1975 $13.50 [9J]

Microprocessors: Technology, Architecture and Applications

Daniel R. McGlynn. This introduction to the microprocessor defines and describes the related computer structures and electronic semi-conductor processes. Treats both hardware and software, giving an overview of commercially available microprocessors, and helps the user to determine the best one for him/her. 240 pp. $12.00 [7C]

Software Design for Microprocessors

Wester and Simpson. A complete stand-alone guide for beginner or professional which presents the basics of microprocessor machine code and assembly language. The first chapter starts with basic terms, then gets into machine architecture with a detailed look at instructions and addressing. Succeeding chapters present the process of generating software, designing a simple demonstration machine as well as four comprehensive sample problems. 350 pp. 1976 $12.95 [9D]

MICRO COMPUTER HANDBOOK

Microcomputer Handbook

Charles J. Sippl. A comprehensive microcomputer reference guide for designers, users, students, and hobbyists. Covers microcomputer design; software and programming techniques; available products, kits, and development systems; comparison of micros, minis and standard systems; and applications including use in control systems, businesses, banks, factories, and homes. A vital reference. 480 pp. 1977. $19.95 [7N]

Build Your Own Working Robot

David Heiserman. Complete plans, schematics and logic circuits for building a robot. Not a project for novices, this robot is a sophisticated experiment in cybernetics. You build him in phases and watch his capabilities increase and his personality develop. Phase I is leash led, Phase II has a basic brain, while Phase III responds and makes decisions. 238 pp. 1976 $5.95 [9M]

Introduction To Microcomputers: Basic Concepts

Adam Osborne. This book became a leading text in colleges and universities just a few months after release. The book assumes no prior knowledge of computers; therefore, computer concepts are described, beginning with first principles, binary arithmetic and boolean algebra. The book covers in depth memory organization, the microprocessor CPU, I/O logic, programming, and then discusses a hypothetical instruction set. 304 pp. (1976) $7.50 [9k]

An Introduction to Microcomputers — Vol. 2: Some Real Products (2nd Edition)

Adam Osborne. Covers over 20 real microprocessors (4, 8, and 16 bit) in considerable detail. For example, 19 timing diagrams are presented for using the 8080A call instruction as an interrupt response. Also covers major chip slice products. 304 pp. 1977. $15.00 [9L]

Computing Milieu

PCC's Reference Book of Personal and Home Computing

Ever try to find the address of a manufacturer of a cassette interface that a friend told you about 2 weeks ago? Frustrating isn't it? This book will go a long way towards ending that frustration with its comprehensive list of manufacturers, stores, and products. Also contains survey articles on software, hardware, kits, and applications as well as an index of articles from various hobbyist magazines. Several bibliographies too. 1977. $4.95 [7P]

COMPUTER
LIB

Computer Lib/ Dream Machine

Ted Nelson. **This book is devoted to the premise that everybody should understand computers. In a blithe manner the author covers interactive systems, terminals, computer languages, data structures, binary patterns, computer architecture, mini-computers, big computers, microprocessors, simulation, military uses of computers, computer companies, and much, much more. Whole earth catalog style and size. A doozy! 127 pp. $7.00 [8P]**

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Dennis A. King. The Guide is written for hams, CBers, Experimenters, and Computer Hobbyists. It lists a wide range of parts, supplies, and services categorized by firms, products, and geographic location and completely cross-referenced. Covers 250 product categories and 650 firms from tiny to huge. 200 pp. 1977. $5.95 [7K]

LOOK!

Freedom's Edge

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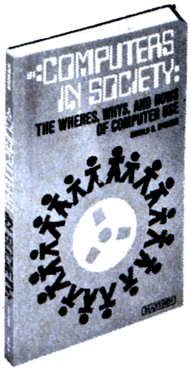

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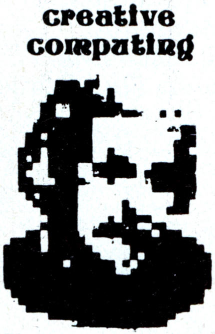

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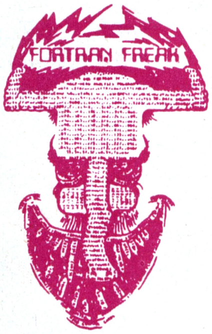

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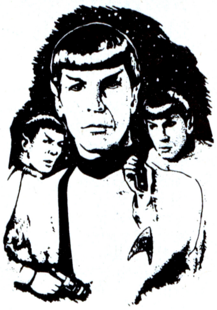

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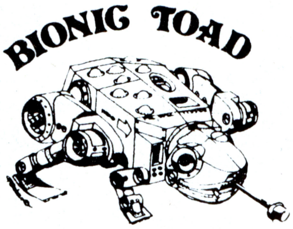
Hot pink design, yellow shirt.



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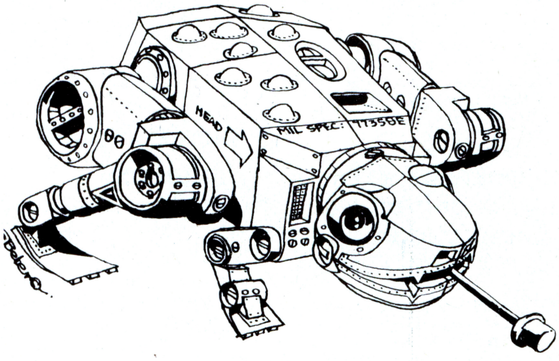

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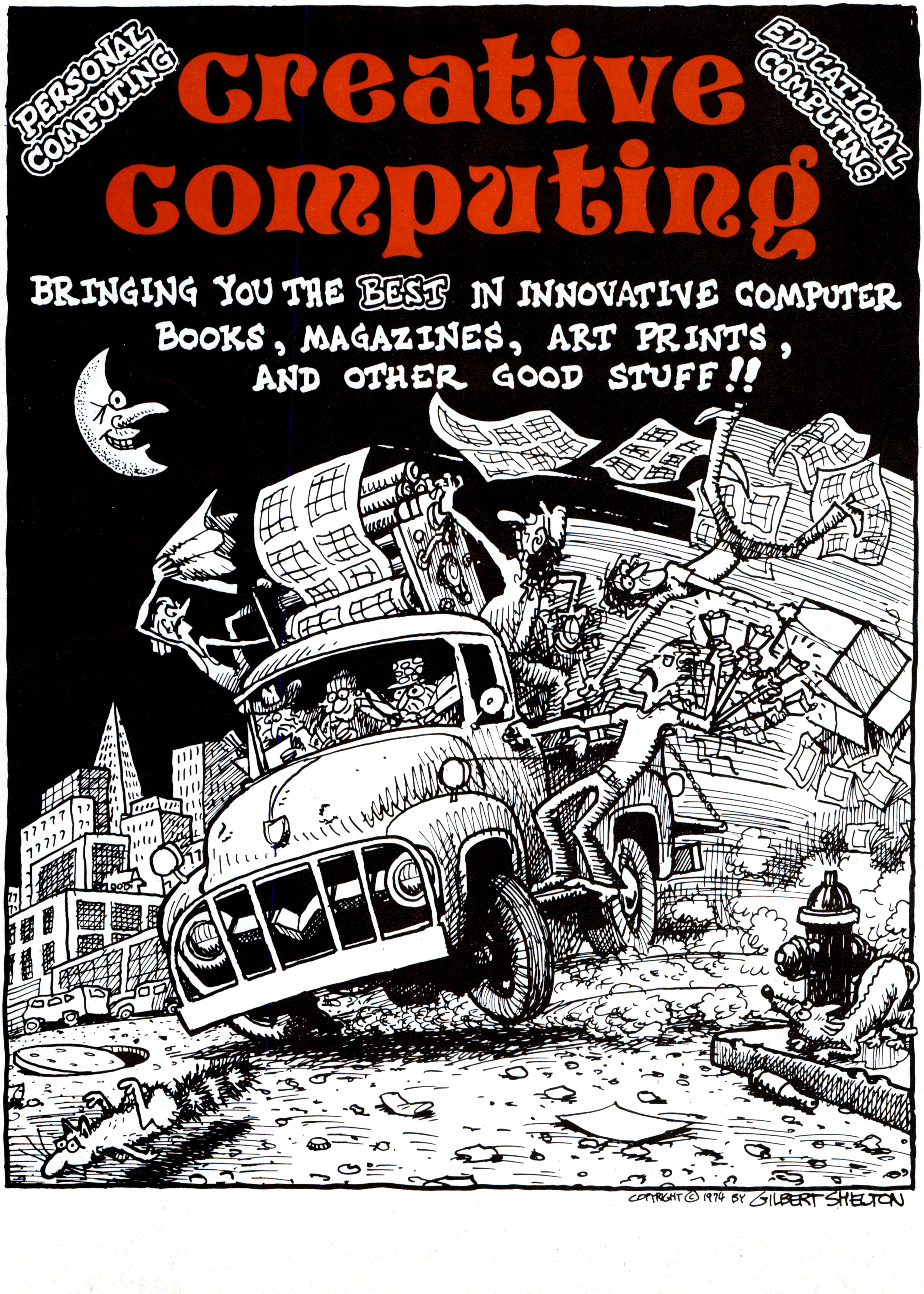
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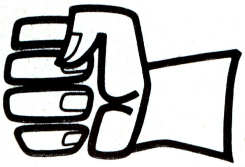

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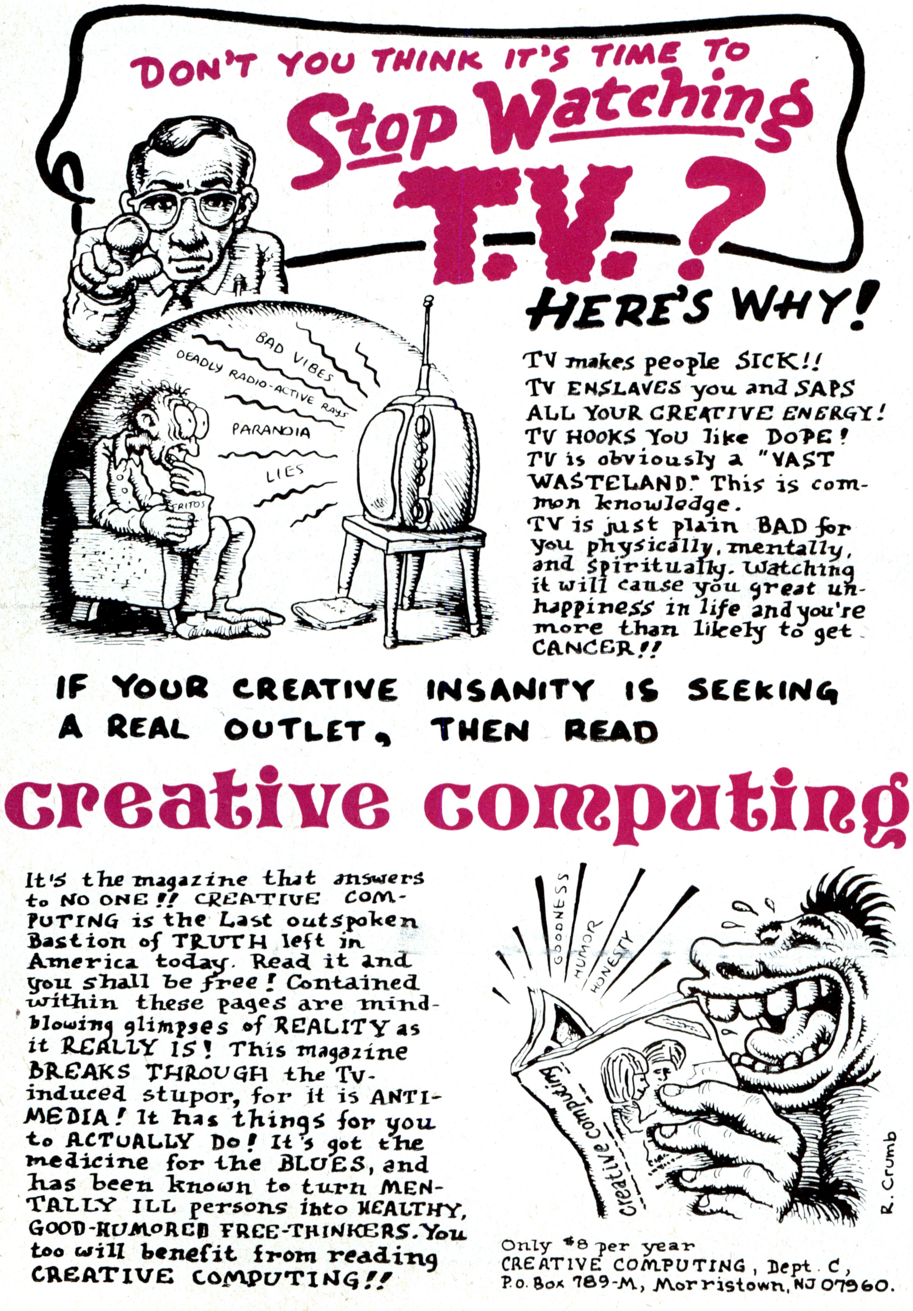
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puzzles & problems

Number Game

Write a BASIC program to simulate this Number Game that appeared in the latest issue of *Zephrus: De-Schooler Primer.*

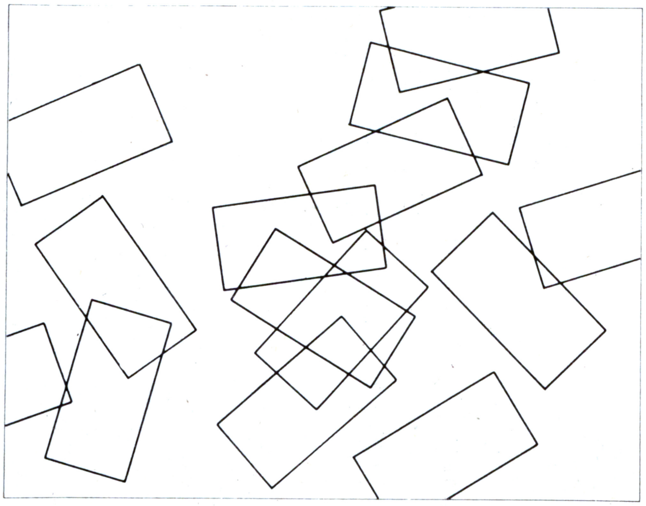
Equipment:	2 dice and a score sheet. Each die numbered from 1 to 6. Score sheet numbered from 1 to 100 with a blank beside each number.
Rules:	Each player (you vs. the Computer?) rolls the dice. The object is to fill the blanks on the score sheet using the numbers on each die in any arithmetic operation. Only one operation may be used.
Strategy:	With a roll of 2 and 6 the player could elect to fill in either the 2, the 6, the 4 (6-2), the 8 (6+2), the 12 (6×2), the 3 (6/2), the 36 (6^2), or the 64 (2^6).

The winner? The player that fills the most blanks!

Drop It

Cut out a cardboard rectangle 1-1/2" x 3". Drop it from a height of about 2 feet onto an 8-1/2" x 11" sheet of paper laid flat on a table. Outline the rectangle where it falls with a "Flair" type pen. Repeat 15 times.

Write a program to determine the probability of one rectangle touching one other, two others, and so on. How do the results from your program compare to your drawing? Try it for 30 drops. Any improvement?



False Cancellation

The equation 16/64 = 1/4 is a result obtained by the cancellation of the 6 in the numerator and denominator. Find all the cases in which AB/BC = A/C for A, B, and C integers between 1 and 9 inclusive. Do not consider obvious special cases such as 22/22, 33/33, etc.

Squared Sums

The four digit number 3025 has the following property: if the number formed by considering only the first two digits (30) is added to the number formed by considering only the last two digits (25) (the total will be 55), and if this number (55) is squared, the result will be the original number:

$$(55)^2 = 3025$$

Find all 4 digit numbers having this property. Do *not* check numbers beyond 9900 since 9901 would be arranged as

$$99 + 01 = 100 \text{ and } (100)^2 = 10000$$

which is a *5* digit number.

Sequential

What is the next number in the sequence:
9, 7, 7, 9, 13, 10, 9, ?

Too Many Coconuts

There are 3 pirates and a monkey on a desert island who have gathered a pile of coconuts to be divided the next day. During the night one pirate arises, divides the pile into 3 equal parts and finds one coconut left over, which he gives to the monkey. He then hides his share away from the pile. Later during the same night, each of the other two pirates, in turn, arise and repeat the performance of the first pirate. In the morning all 3 pirates arise, divide the pile into 3 equal shares and find one left over which is given to the monkey. How many coconuts were in the original pile? Since the result is not unique, find all values from 1 to 1000 that satisfy the conditions.

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7422N	.47	74121	.35		
7423N	.37	74122	.49		
7425N	.39	74123	.65		
7426N	.35	74125	.58		
7427N	.35	74126	.58		
7428N	.49	74132	1.05		
7430N	.22	74136	1.10		
7432N	.31	74141	1.10		
7437N	.27	74142	3.75		
7438N	.27	74143	3.95		
7440N	.22	74144	4.95		
7441N	.85	74145	1.05		
7442N	.59	74147	2.25		
7443N	.75	74148	1.79		
7444N	.75	74150	.95		
7445N	.75	74151	.75		
7446N	.79	74153	.90		
7447N	.65	74154	1.29		
7448N	.75	74155	.99		
7450N	.22	74156	.95		
7451N	.26	74157	.95		
7453N	.26	74158	1.79		
7454N	.22	74160	1.20		
7459N	.29	74161	.95		
7460N	.29	74162	.95		
7470N	.44	74163	.95		
7472N	.36	74164	1.05		
7473N	.36	74165	1.05		
7474N	.31	74166	1.00		
7475N	.48	74170	2.49		
7476N	.36	74172	8.49		
7479N	4.70	74173	1.49		
7480N	.59	74174	1.25		
		74175	.90		
		74176	.90		
		74177	.90		
		74180	.89		
		74181	2.39		
		74182	.95		
		74184	2.10		
		74185	2.25		
		74186	14.50		
		74190	1.15		
		74191	1.15		
		74192	.99		
		74193	.99		
		74194	1.39		
		74195	.75		
		74196	1.19		
		74197	1.19		
		74198	1.69		
		74199	1.69		

74LS00 TTL

74 LS00	.22	LS155	1.49
LS02	.24	LS157	1.29
LS04	.24	LS158	1.29
LS05	.28	LS161	1.39
LS08	.28	LS162	1.39
LS10	.28	LS163	1.39
LS13	.79	LS164	1.39
LS14	1.69	LS174	1.39
LS20	.26	LS175	1.39
LS27	.38	LS190	2.49
LS30	.26	LS191	2.49
LS32	.34	LS192	2.49
LS40	.26	LS193	2.49
LS42	1.10	LS194	2.49
LS51	.26	LS195	.52
LS73	.56	LS251	1.39
LS74	.56	LS253	1.49
LS75	.79	LS257	1.29
LS76	.59	LS258	1.29
LS83	1.69	LS279	1.10
LS85	1.99	LS283	1.10
LS86	.55	LS367	.99
LS90	1.10	LS368	.99
LS92	1.10	LS377	1.29
LS93	1.10	LS378	1.29
LS95	1.69	81LS95	1.10
LS107	.56	81LS96	1.10
LS109	.56	81LS97	1.10
LS112	.56	81LS98	1.10
LS113	.56		
LS123	.99		
LS132	1.10		
LS136	.99		
LS138	1.39		
LS139	1.49		
LS151	1.49		
LS153	1.29		

74S & 74L

74S00	.40	74L00	.39
74S04	.42	74L04	.39
74S08	.49	74L10	.39
74S10	.40	74L20	.39
74S11	.40	74L30	.39
74S20	.40	74L42	1.29
74S30	.40	74L73	.89
74S32	.78	74L74	.89
74S37	.85	74L85	1.49
74S38	.95	74L86	1.49
74S40	.40	74L90	1.29
74S74	.79	74L95	1.29
74S138	1.69	74L154	1.59
74S139	1.69	74L164	1.69
74S151	1.49	74L165	1.89
74S158	1.49	74L192	1.99
74S174	1.59	74L193	1.99
74S175	1.59		
74S189	2.95		
74S201	3.95		
74S251	1.69		
74S257	1.69		

4000 CMOS

CD4000	.25	CD4027	.59	4508	3.95	74C154	2.75
CD4001	.25	CD4028	1.50	4510	1.99	74C160	1.40
CD4002	.25	CD4029	1.70	4511	1.99	74C161	2.10
CD4006	1.69	CD4030	.42	4515	3.95	74C174	2.10
CD4007	.25	CD4033	2.49	4516	1.99	74C192	2.39
CD4008	1.69	CD4034	4.95	4518	1.99	74C193	2.39
CD4009	.55	CD4035	1.79	4520	2.49	74C221	2.65
CD4010	.55	CD4040	1.05	4522	2.56		
CD4011	.25	CD4041	1.95	4526	2.56		
CD4012	.25	CD4042	1.45	4527	2.69		
CD4013	.55	CD4043	1.45	4528	1.50		
CD4014	1.95	CD4044	1.45	4531	1.99		
CD4015	1.95	CD4047	1.95	4532	2.69		
CD4016	.55	CD4049	.61	4543	2.25		
CD4017	.99	CD4050	.61	4555	1.79		
CD4018	2.39	CD4051	1.25	4556	1.79		
CD4019	.55	CD4052	1.25	4581	4.90		
CD4020	1.39	CD4059	1.95	4582	1.99		
CD4021	1.85	CD4063	2.49	4585	2.49		
CD4022	1.20	CD4068	.35	4901	.49		
CD4023	.29	CD4069	.35	4911	.49		
CD4024	1.25	CD4070	.35	74C00	.35		
CD4025	.29	CD4071	.35	74C04	.35		
CD4026	1.95	CD4072	.35	74C10	.35		
		CD4073	.35	74C20	.35		
		CD4075	.35	74C30	.35		
		CD4078	.35	74C42	1.95		
		CD4081	.40	74C48	2.90		
		CD4082	.40	74C73	.85		
		CD4094	2.49	74C74	.85		
		CD40160		74C76	1.39		
		40160	2.10	74C85	1.25		
		40161	2.10	74C86	1.79		
		40174	2.10	74C89	4.95		
				74C90	1.25		
				74C93	1.35		
				74C95	1.49		
				74C106	1.49		
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LM306H	.95	LM723CH	.55
LM307CN	.45	LM725CH	3.25
LM307H	.45	LM733N	1.00
LM308H	1.00	LM733H	1.29
LM308CN	1.00	LM739N	1.29
LM309H	1.10	LM741CH	.35
LM309K	1.25	LM741CN	.39
LM310H	1.15	LM747N	.75
LM311H	.90	LM747H	.75
LM311CN	.59	LM748H	.39
LM312H	1.95	LM748N	.39
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LM370H	1.65	LM3900N	.55
LM373N	3.95	LM3909	1.10
LM377N	4.50	LM7520	2.25
LM380N	1.00	LM7524N	1.75
LM381N	1.90	LM7525N	1.90
LM384N	2.49	LM7534N	2.20
LM555CN	.59	LM7535N	1.25
LM556CN	1.69	75324	3.50
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LM565CN	1.95	SG3524	8.95
LM565H	1.95	RC4194T	6.95
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		RC1458CN	.89
		RC1556CN	.99
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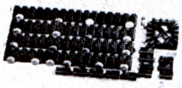

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puzzles & problems

SOLITAIRE

Here is an interesting solitaire game which can be played on a 6x6 corner of a checkerboard or, better yet, programmed for the computer.

The first cell (top lefthand corner) is empty; all the others contain checkers, chips, beans, etc. The problem is to reduce the checkers to one and finish with the last checker in Cell 1. A move is defined as any one checker jumping one other checker in a single straight-line step (no diagonals), and then removing the jumped-over checker from the board.

1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24
25	26	27	28	29	30
31	32	33	34	35	36

LADDER IN ALLEY

Write a program to determine the longest ladder that can be carried in a horizontal position around a corner in Genoa when a 4-meter alley meets one 2.5 meters wide.

TILE FLOORS

Two square rooms in a house were tiled with 2,120 tiles, each a foot square. Each side of one floor is 12 feet longer than each side of the other. What were the dimensions of the two floors?

COMPUTER RECREATIONS

by D. Van Tassel

Knight's and King's Tours

The knight in chess can also be used for some interesting programs. The knight can move one square vertically or horizontally and then two squares at right angles, or vice versus. Here is a program using knights: Write a program to determine the maximum number of knights which can be put on one chess board so no knight can capture another knight. If you think about this, the solution is fairly easy. I will print a solution in a later column.

A famous problem using a knight is called the Knight's Tour: Write a program with the knight starting at some position and have the knight visit each square on the chess board *once* and *only once*. There are many solutions to this problem. One solution is in the book *BASIC Programming* by Kemeny and Kurtz, John Wiley & Sons.

A final chess problem is called the King's Tour. Starting with a king in its normal position have the king visit each square once and only once.

If anyone knows of any other interesting programs to write using chess pieces, please send them to me and I will try to use them in a later column.

FLAGSTONE WALK

A man has red, gray, and blue flagstones for making a walk (one stone wide). How shall he lay them so that no pattern is immediately repeated and how many can be so laid? That is, no consecutive stones may have the same color; no consecutive pairs of stones may have the same colors in the same order; no three stones may show the same sequence as the preceding three; and so on. For purpose of computer solution, you may represent the different color flagstones by the integers 0, 1, and 2.

Thinkers' Corner

by Layman E. Allen ©

WORD PUZZLES

How many of the problems (a) through (f) below can you solve by forming a network of words that have exactly as many letters as the number listed as the GOAL? (Suppose that each symbol below is imprinted on a disc.)

To qualify as a network

(1) all sequences of discs across and down must be words,

(2) the words must have two or more letters and not be proper names,

(3) all of the discs in the REQUIRED column must be used,

(4) as many of the discs in PERMITTED as you wish may be used, and

(5) at most one of the discs in RESOURCES may be used.

Example: The number of letters in the words of the network

```
CAT    is 7:        CAT=3, TO=2, ON=2
  ON                 3 + 2 + 2 = 7
```

The number in the network CAT is 3.

Problem	GOAL	REQUIRED	PERMITTED	RESOURCES
(a)	7	BCY	AT UW	CEGHI RS
(b)	9	AEK	ABLMT	BCDMSTV
(c)	10	ADI	AERR	BEGMORY
(d)	11	AELR	ADLMR	ABCI JKL
(e)	14	ENO	AGNOT	ACKMNTU
(f)	18	EHT	BENOWW	ABNOPST

If you enjoy this kind of puzzle, you may like playing ON-WORDS: The Game of Word Structures. Free information about this and other instructional games is available upon request from The Foundation for the Enhancement of Human Intelligence, 1900-W Packard Road, Ann Arbor, MI 48104.

Some Suggested Answers (frequently there are others):

(a)

```
  C
  I
  T
BAY
```

(c)

```
 AIR
 R
DEAR
```

(e)

```
 NOT
GONE
   N
```

(b)

```
   T
   A
TABLE
   K
```

(d)

```
  R
 READ
  A
ALL
```

(f)

```
   R
  HE
 WON
NEWT
```

DIODES/ZENERS

1N914	100v	10mA	.05
1N4004	400v	1A	.08
1N4005	600v	1A	.08
1N4007	1000v	1A	.15
1N4148	75v	10mA	.03
1N753A	6.2v	z	.25
1N758A	10v	z	.25
1N759A	12v	z	.25
1N4733	5.1v	z	.25
1N5243	13v	z	.25
1N5244B	14v	z	.25
1N5245B	15v	z	.25

SOCKETS/BRIDGES

8-pin	pcb	.25	ww	.45
14-pin	pcb	.25	ww	.40
16-pin	pcb	.25	ww	.40
18-pin	pcb	.25	ww	.75
22-pin	pcb	.45	ww	1.25
24-pin	pcb	.35	ww	1.25
28-pin	pcb	.35	ww	1.45
40-pin	pcb	.50	ww	1.95

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2N2907	PNP			.15
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2N3906	PNP			.10
2N3054	NPN			.35
2N3055	NPN	15A	60v	.50
T1P125	PNP	Darlington		.35
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XAN72	7 seg com-anode			1.50
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4001	.20
4002	.20
4004	3.95
4006	1.20
4007	.35
4008	1.20
4009	.30
4010	.45
4011	.20
4012	.20
4013	.40
4014	1.10
4015	.95
4016	.35
4017	1.10
4018	1.10
4019	.70
4020	.85
4021	1.35
4022	.95
4023	.25
4024	.75
4025	.35
4026	1.95
4027	.50
4028	.95
4030	.35
4033	1.95
4034	2.45
4035	1.25
4040	1.35
4041	.69
4042	.95
4043	1.25
4044	.95
4046	1.50
4049	.80
4050	.60
4066	1.35
4069	.40
4071	.35
4082	.45

— T T L —

7400	.15
7401	.15
7402	.20
7403	.20
7404	.15
7405	.25
7406	.35
7407	.55
7408	.25
7409	.15
7410	.10
7411	.25
7412	.30
7413	.45
7414	1.10
7416	.25
7417	.40
7420	.15
7426	.30
7427	.45
7430	.15
7432	.30
7437	.35
7438	.35
7440	.25
7441	1.15
7442	.55
7443	.85
7444	.45
7445	.80
7446	.95
7447	.95
7448	.95
7450	.25
7451	.25
7453	.20
7454	.25
7460	.40
7470	.45
7472	.45

7473	.25
7474	.35
7475	.35
7476	.30
7480	.55
7481	.75
7483	.95
7485	.95
7486	.30
7489	1.35
7490	.55
7491	.95
7492	.95
7493	.40
7494	1.25
7495	.60
7496	.80
74100	1.85
74107	.35
74121	.35
74122	.55
74123	.55
74125	.45
74126	.35
74132	1.35
74141	1.00
74150	1.00
74151	.75
74153	.95
74154	1.05
74156	1.15
74157	.65
74161	.85
74163	.95
74164	.60
74165	1.50
74166	1.35
74175	.80

74176	1.25
74180	.85
74181	2.75
74182	.95
74190	1.75
74191	1.35
74192	1.65
74193	.85
74194	1.25
74195	.95
74196	1.25
74197	1.25
74198	2.35
74221	1.00
74367	.85
75108A	.35
75110	.35
75491	.50
75492	.50
74H00	.25
74H01	.25
74H04	.25
74H05	.25
74H08	.35
74H10	.35
74H11	.25
74H15	.30
74H20	.30
74H21	.25
74H22	.40
74H30	.25
74H40	.25
74H50	.25
74H51	.25
74H52	.15
74H53J	.25
74H55	.25

74H72	.55
74H101	.75
74H103	.75
74H106	.95
74L00	.35
74L02	.35
74L03	.30
74L04	.35
74L10	.35
74L20	.35
74L30	.45
74L47	1.95
74L51	.45
74L55	.65
74L72	.45
74L73	.40
74L74	.45
74L75	.55
74L93	.55
74L123	.55
74S00	.55
74S02	.55
74S03	.40
74S04	.35
74S05	.35
74S08	.35
74S10	.35
74S11	.35
74S20	.35
74S40	.25
74S50	.25
74S51	.45
74S64	.25
74S74	.40
74S112	.90
74S114	1.30

74S133	.45
74S140	.75
74S151	.35
74S153	.35
74S157	.80
74S158	.35
74S194	1.05
74S257(8123)	.25
74LS00	.45
74LS01	.45
74LS02	.45
74LS04	.45
74LS05	.55
74LS08	.45
74LS09	.45
74LS10	.45
74LS11	.45
74LS20	.40
74LS21	.25
74LS22	.25
74LS32	.40
74LS37	.40
74LS40	.55
74LS42	1.75
74LS51	.65
74LS74	.75
74LS86	.75
74LS90	1.30
74LS93	1.00
74LS107	.95
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LM320T12	1.25
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LM340T-15	1.00
LM340T-18	1.00

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LM340K-15	1.25
LM340K-18	1.25
LM340K-24	.95
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LM711	.45

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LM725	1.75
LM739	1.50
LM741 8-14	.20
LM747	1.10
LM1307	1.25
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LM75451	.65
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NE556	.95
NE565	.95
NE566	1.75
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Third in a series, this article shows how to break a problem into simpler subproblems.

THINKING STRATEGIES WITH THE COMPUTER: SUBGOALS

Donald T. Piele and Larry E. Wood*

> *Nothing is more important than to see the sources of invention which are, in my opinion, more interesting than the inventions themselves.*
>
> Leibnitz

One of the earliest and most famous problems in the field of topology (a branch of geometry) is the four-color problem. Conjectured by the English mathematician Francis Guthrie in 1850, it states that any map on a plane or a sphere can be colored with at most four colors so that any two countries that share a common boundary are colored differently. All attempts to prove this conjecture had been unsuccessful until last year when it was announced by kenneth Apple and Wolfgang Haken of the University of Illinois that it was indeed true. While listening to Professor Haken outline the proof at a recent colloquium, we were struck by his frequent use of clearly defined problem-solving strategies. Of paramount importance was the strategy of subgoals. After the problem had been represented in the rich language of graph theory, it was broken down into 1,930 subproblems each of which could be routinely solved on a computer. After 1,200 hours of computer time, the announcement was made, as anyone knows who has recently received a letter postmarked from the Mathematics Department at the University of Illinois.

FOUR COLORS
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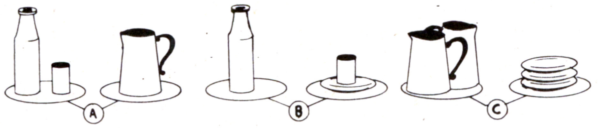
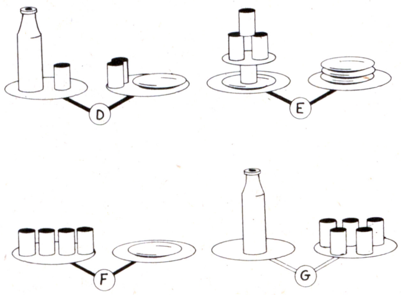
Subgoals

Basically, the method of subgoals consists of breaking a problem into simpler subproblems, solving each part, and regrouping the parts to solve the original problem. We often attack problems this way without thinking of it as a particular strategy since it seems so obvious. However, when we identify this strategy in a variety of problems, we learn how to use it much more effectively. As an example, consider the following balance problem (from Moscow Puzzles). How many glasses will balance a bottle?

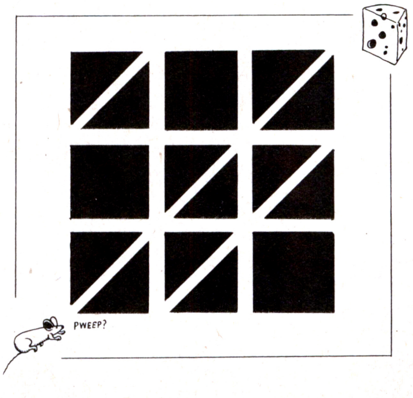


From the information given, it is apparent that the solution will require several step or subgoals. If we spend a few moments actively searching for appropriate subgoals, the solution can be obtained easily. From B, it is obvious that a bottle weighs as much as a glass plus a plate, so to solve the problem it is sufficient to replace the plate by its equivalent weight in glasses. Thus, obtaining a balance between glasses and one plate is a useful subgoal. This relationship is not given explicitly in A, B or C so it is necessary to establish a second subgoal. One possibility is to replace the two pitchers in balance C with glasses and plates. When this second subgoal is achieved, it is possible to reduce the number of plates on both sides until the first subgoal is achieved. The complete solution is:



As a rule, subgoals are easier to attain than the entire goal, and this problem is no exception. Adding a glass to both sides of B yields the balance D. Combining this relationship with A shows that one plate and two glasses balances a pitcher. Hence, the two pitchers in C may be replaced with equivalent plates and glasses as shown in E. This solves the second subproblem which leads to the solution of the first subproblem F and the main problem G.

We next turn to an application of the subgoal strategy where recursive relationships can be used. Polya (1957) advises, "If you can't solve the problem posed, try to solve a simpler related problem." Many times the solutions to simpler problems may be combined and expanded in a recursive way to solve the original problem. As an example, consider the following AMAZE problem. A mouse enters a maze in search of a piece of cheese. There are infinitely many paths the mouse could follow but only a finite number will lead the mouse closer to the goal with every step. How many such paths are there?



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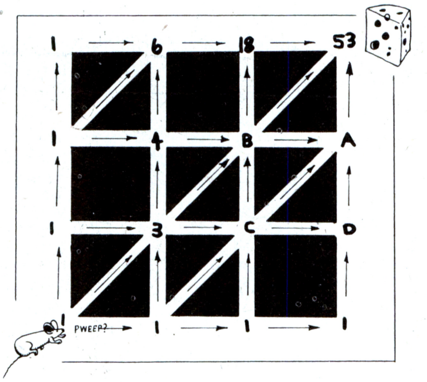
*University of Wisconsin-Parkside, Kenosha, Wisconsin 53140

A poor way to attach this problem is to try to trace all the distinct routes and add them up. A better way is to build from simpler subproblems by placing the cheese at any one of the 14 other intersections. These are certainly related problems since any path that leads to the upper-right-hand corner must pass through a sequence of intersections. Also, the solutions for the simpler problems can be obtained through recursive relationships. There are two AMAZing things about solving the problem this way. The first is that it is really unnecessary to trace all of the paths to count them, and the second is that anyone could solve the problem this way in five minutes or less. For example, the number of paths that lead to intersection A, shown in the next figure, is the sum of the number of paths that lead to B, C and D because the only routes to A are through those intersections. The number of paths to each intersection is found recursively by starting in the lower left hand corner of the figure and moving to the upper right hand corner. As the problem is stated, there are 53 different paths the rat could take to the cheese.

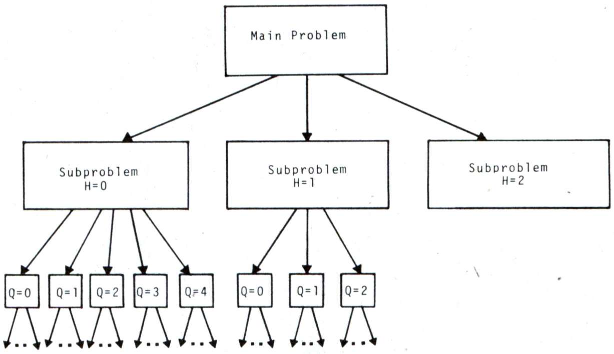


A classic example of the use of recursively defined subgoals appears in the solution to the Tower of Brahma (Hanoi) puzzle (see *Creative Computing,* January-February, 1976 and Wickelgren, 1974).

Change for a Dollar

There are many ways, similar to those above, to apply the subgoal strategy to sole problems with the aid of a computer. A good example appears in the solution to the DOLLAR problem posed for *Creative Computing* by Brian Hess (1976): How many ways can you change a dollar bill?

Begin the solution by searching for ways to divide the problem into a set of smaller subproblems, each of which is easier to solve. One way to do this is illustrated by the tree diagram:



The main problem is broken up into three subproblems: the number of ways of making change for one dollar using,

1. No half dollars (H = 0),
2. One half dollar (H = 1), or
3. Two half dollars (H = 2).

The last problem is trivial (only one way), while the other two need to be broken down further. This is done by dividing the remaining money into quarters and considering subproblems that specify the number of quarters (Q) used. Continuing on to lower denominations, subgoals are established that specify dimes (D), and nickels (N). As the number of subproblems is expanded, each one becomes easier to solve. In fact, with this problem, subgoals are reached which can be solved in only one way. For example, if H = 1, Q = 1, D = 2, and N = 0, then the pennies (P) must equal five in order to total up to one dollar.

While it is possible to continue the tree diagram in the figure by hand, it is very laborious to do so. However, it is a simple matter to program the computer to keep track of each subproblem with nothing more than nested loops. To demonstrate this, program DOLLAR was written so that each loop breaks the main problem down according to the scheme shown in the figure. Notice that at the quarter stage Q and thereafter, adjustments are made on the limits of the loops depending on how much money is left to change. For example, if H = 1 the only possible subgoals for quarters are Q = 0, 1, or 2 but not 3 or 4. Also, notice that there is no need to test combinations of coins to see whether they add up to $1.00. Simply counting the number of subgoals is sufficient since each one can be solved in only one way, (i.e., once H,Q,D, and N are specified then P must equal 100-50H-25Q-10D-5N).

Recursion Relationships

Another way to attack this problem was suggested by Polya (1957) and uses recursion relationships in a similar way to that shown in the solution to AMAZE. Begin by defining quantities which represent the number of ways to make change for n cents using specified coins.

A_n only pennies
B_n nickles and pennies
B_n nickles and pennies
C_n dimes, nickels, and pennies
D_n quarters, dimes, nickles, and pennies
E_n half dollars, quarters, dimes, nickels, and pennies
The problem is to find E_n for n = 100.

We can distinguish two cases in making change for n cents:

1. No half dollars are used, in which case D_n is the number of ways to change n cents, or
2. One or more half dollars are used. After one half dollar is paid, there remains n - 50 cents to pay which can be done in E_{n-50} ways.

Since these two cases are mutually exclusive, we can infer that

$E_n = D_n + E_{n-50}$,

Similarly,

$D_n = C_n + D_{n-25}$

$C_n = B_n + C_{n-10}$

$B_n = A_n + B_{n-5}$

Now we begin with the simplest cases and build up to E_{100}. First of all, it is easy to understand why $E_0 = 1$. From above, when n = 50, $E_{50} = D_{50} + E_0$, and it is possible to make change for 50 cents only *one* more way if half dollars are allowed. Therefore $E_0 = 1$. Likewise, we can argue that $D_0 = C_0 = B_0 = A_0 = 1$. It is also true that $A_n = 1$ for all values of n since there is only one way to make change using only pennies. We are now ready to apply the recursive relationships to solve the original problem. This is the strategy followed in program CHANGE which also has the added advantage that it can count the number of wasy of making change (with coins) for any specified number of cents, n.

Conclusion

Forming subgoals is certainly one of the more common problem-solving strategies. Mathematical induction, recursion, and tree diagrams all contribute to its versatility. When used in conjuction with the computer, this strategy promises applications for solving old problems in new syas and for solving new problems in ways yet to be discovered.

Postscript

The Dollar Problem has been around for some time and can be solved using analytical techniques. Kac and Ulam (1968) discuss a solution to this problem using power series. Specifically, if

$P(x) \times 1 + x + x^2 + x^3 + x^4 + \ldots$

$N(x) = 1 + x^5 + x^{10} + x^{15} + x^{20} \ldots$

$D(x) = 1 + x^{10} + x^{20} + x^{30} + x^{40} \ldots$

$Q(x) = 1 + x^{25} + x^{50} + x^{75} + \ldots$

$H(x) = 1 + x^{50}\, x^{100} + x^{150} + \ldots$

then the product series $\pi(x) = P(x)N(x)D(x)Q(x)H(x)$ is the key to finding the number of ways of making change for n cents. For example, the coefficient of the term x^{100} in the product series $\pi(x)$ is the number of ways to make change for a dollar bill. Note, $1 \cdot x^5 \cdot x^{20} \cdot x^{25} \cdot x^{50} = x^{100}$ and this product corresponds to making change for one dollar using a half dollar (x^{50}), a quarter (x^{25}), two dimes (x^{20}), a nickel (x^5) and no pennies (1) and at the same time contributes 1 to the coefficient of x^{100} in the product series $\pi(x)$. However, finding this coefficient by power-series analysis is very tedious and requires a high degree of mathematical sophistication. On the other hand, by making this connection between the coefficients of $\pi(x)$ and changing money, we can turn the table around and use program CHANGE to compute the coefficients for the product series $\pi(x)$ very quickly.

Suppose we expand AMAZE so that a computer program would be necessary for finding a solution quickly. Can you write a program that will handle any specified arrangement of blocks, some which have alleys? If a certain proportion of the blocks has alleys, how should be blocks be arranged so that the number of paths to the goal is maximized?

Russian coins made of copper and nickel come in denominations of 10, 15, 20, 50, and 100 kopecks (100 kopecks = one ruble). Copper-zinc coins come in denominations of 1,2,3, and 5 kopecks. How many ways are there to make change for one ruble?

References

Hess, B. "How Many Ways Can You Change A Dollar?" *Creative Computing,* September-October 1976, p.70.

Kac, M., and Ulam, S. *Mathematics and Logic,* Frederick Praeger, Publishers, New York, 1968, pp. 24-26.

Polya, G. *How to Solve It,* Princeton University Press, Princeton, New Jersey, 1957: 252-253.

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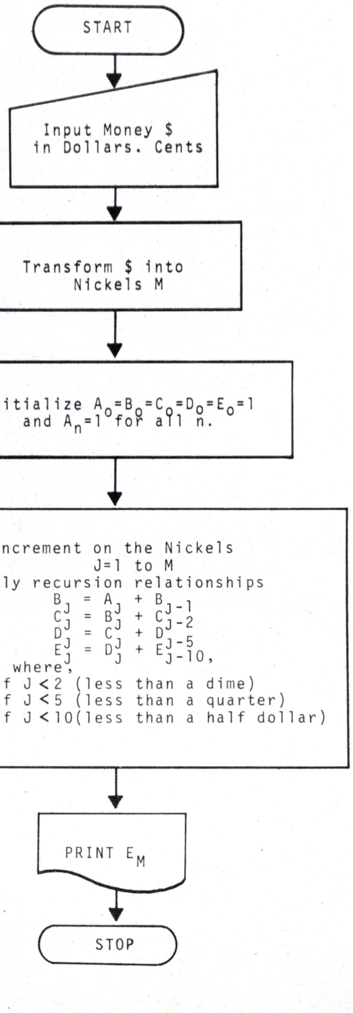
Wickelgreen, AW.A. *How to Solve Problems,* W.H. Freeman and Company, San Francisco, 1974, p. 103.

Illustrations by Rodney Schroeter.

CHANGE PROGRAM

```
10   PRINT 'PROGRAM CHANGE COMPUTES THE NUMBER OF WAYS OF MAKING'
20   PRINT 'CHANGE IN COINS FOR ANY AMOUNT OF MONEY UP TO $5.00.'
30   PRINT
40   DIM A[101],B[101],C[101],D[101],E[101]
50   PRINT 'HOW MUCH DO YOU WANT TO CHANGE?'
60   PRINT 'INPUT $ AS DOLLARS. CENTS ';
70   INPUT C
80   M=INT(20*C)+1
90   A[1]=B[1]=C[1]=D[1]=E[1]=1
100   FOR J=2 TO M
110   A[J]=1
120   B[J]=A[J]+B[J-1]
130   C[J]=B[J]
140   IF J <= 2 THEN 160
150   C[J]=B[J]+C[J-2]
160   D[J]=C[J]
170   IF J <= 5 THEN 190
180   D[J]=C[J]+D[J-5]
190   E[J]=D[J]
200   IF J <= 10 THEN 220
210   E[J]=D[J]+E[J-10]
220   NEXT J
230   PRINT
240   PRINT 'YOU CAN MAKE CHANGE FOR $ ';C
250   PRINT 'IN  ';E[M];'DIFFERENT WAYS.'
260   END
```

CHANGE FLOWCHART


START
Input Money $ in Dollars. Cents
Transform $ into Nickels M
Initialize $A_0=B_0=C_0=D_0=E_0=1$ and $A_n=1$ for all n.
Increment on the Nickels
J=1 to M
Apply recursion relationships
$B_J = A_J + B_{J-1}$
$C_J = B_J + C_{J-2}$
$D_J = C_J + D_{J-5}$
$E_J = D_J + E_{J-10}$,
where,
$C_{J-2}=0$ if $J<2$ (less than a dime)
$D_{J-5}=0$ if $J<5$ (less than a quarter)
$E_{J-10}=0$ if $J<10$(less than a half dollar)
PRINT E_M
STOP

SAMPLE RUN

```
PROGRAM CHANGE COMPUTES THE NUMBER OF WAYS OF MAKING
CHANGE IN COINS FOR ANY AMOUNT OF MONEY UP TO $5.00.

HOW MUCH DO YOU WANT TO CHANGE?
INPUT $ AS DOLLARS. CENTS ?5.00

YOU CAN MAKE CHANGE FOR $  5
IN   59576      DIFFERENT WAYS.

DONE
```

DOLLAR PROGRAM

```
10  REM ***PROGRAM DOLLAR COMPUTES THE NUMBER OF WAYS OF
20  REM ***MAKING CHANGE FOR ONE DOLLAR.
30  C=0
40  FOR H=0 TO 2
50  FOR Q=0 TO 4-2*H
60  FOR D=0 TO 10-5*H-.5*Q
70  FOR N=0 TO 20-10*H-5*Q-2*D
80  C=C+1
90  NEXT N
100  NEXT D
110  NEXT Q
120  NEXT H
130  PRINT "THERE ARE"C;"DIFFERENT WAYS TO CHANGE A DOLLAR BILL."
140  END
```

SAMPLE RUN

```
THERE ARE 292  DIFFERENT WAYS TO CHANGE A DOLLAR BILL.

DONE
```

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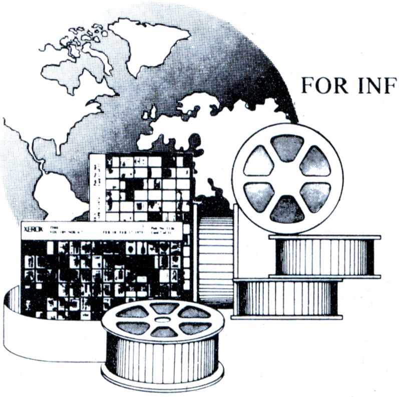

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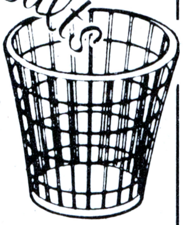

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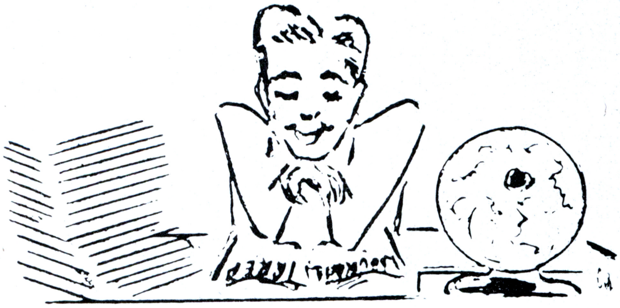


A Journal Of

Satire And Humor

Read From Cover To Cover

The Case of the Reader Uncovered
or
The Clue From the 41 Square Boxes

Burchenal Green

Since Sherlock Holmes is able to use an "analytical machine" on other pages of this very issue, along with the wit and quickness of mind that are so characteristic of him, to solve a most difficult problem, I thought perhaps he could help figure out who you *Creative Computing* readers are. But alas, he was unavailable, except in the example he set. I know you want to know about yourself. We all have a great curiosity these days to learn who we are, technology reshapes our lifestyles so quickly. In the absence of the eminent Mr. Holmes I turned instead to professional help from Stuart Varden, Howard Spivak and David Wilder, who respectively teach courses in Computing in Education, SPSS, and Survey Methodology at Teacher's College, Columbia. They all very kindly agreed to help me find out who you, the readers of *Creative Computing,* are, probably not realizing all the trouble I was going to be, or I, how much work is involved in doing a good readership survey.

My first task was to decide what actual physical means I could use to ask the questions, and the options, each with different expected results, were enormous. But so was the range of costs. I chose to include a survey form in the November/December issue that was comprised of one page with 41 questions of boxes to fill in, and a space for comments. The magazine could't afford the cost of binding in a pre-paid self-mailer questionnaire so we had to ask the reader's cooperation in xeroxing the survey page or in ripping it out of the magazine, and in providing your own stamp and envelope. In way of some token of compensation we offered a drawing of survey forms, the first prize winner to receive a three-year subscription or renewal of *Creative Computing* and the second and third prize winners to get a one-year subscription or renewal each. We numbered each questionnaire as it was received and on January 12th used the BASIC random-number generator in the GE Timesharing System to get three numbers. The winners were Ed Langlin, Santa Barbara, California; John Rabenaldt, Odessa, Texas; and Jim Denning, San Francisco, California.

After it was decided to trust to our readers' filling out a page in the magazine, the next decision was that of figuring out what to ask. "You don't get a chance when you're doing the analysis to second-guess your subject," David Miller warned. "Make sure you think out what you need to know and that your survey instrument asks that. You can't analyse what you forgot to ask. But," he concluded, with the resignation of a professional, "almost everybody always wishes during analysis they'd included other questions." (How right he was. Are you readers ready for another survey later this year?)

"Keep the instrument simple and short," Howard Spivak advised, when I brought him handwritten pages of questions and comments. "People are busy. If you can limit your response to a checked box, maybe, just maybe, they'll fill it in. But don't ask them for a write-up on each question. They may want to answer, and even start the form, but chances are good they'll never finish it. Then you have nothing. Keep the response to checking boxes. You're already asking the readers to supply their own envelope and stamp."

What to ask readers had to be questions that would clearly elicit what they read and wanted to read. We are fortunate enough to be able to get a large quantity of excellent articles by renowned experts in every area of the field. They fascinate me as I read them, edit them, and rush them to the typesetter, thinking, "I can't wait for our readers to find out about that." That article gets on the "must run" list for the next issue. Then the day comes for the next issue to be assembled, the *final* no-time-left number-the-pages day when the some 250 pages of great material that must have gotten in, didn't. Not to mention all the "I-wish-I-had-room-for material." Amid great wailings, bemoanings and curses, favored articles move from the "must-get-in" pile, no page number on the bottom, to the "wish-there-was-room-for" pile. It isn't an easy decision to figure what's best to include as the contents of each issue. Variety is important. Information on new items of import will always get in, as well as good source material. Aside from that, letters to the editor, phone calls, remarks overhead, that say what you've liked and read, play a large part in dictating that final decision of what will be included.

When Dave pointed out that we got more letters about "Shuffling" than almost any other single article, we knew we had to run "Shuffling Revisited," the demand was so great. In each day's mail come letters requesting information on other languages which forced us not to hold PILOT and "A Taste of APL" on decision day. What we hoped the readership survey would do would be provide us with an even more clearcut picture of what you do read and want to read, something encompassing all types of articles, to help us in our decision-day crazies.

Information about the reader was also needed to plan future directions of the magazine and to answer questions of advertisers. I like the advertising we've run in the magazine. I find it extremely helpful to know what's available on the market and I thought many readers felt the same way. What gluttons we are in this day and age for information. But many advertisers, quite understandably, are curious to know who you readers are, to ascertain if you'd be interested in their products. I needed job, age, computer usage and potential buying information. In writing the questions of the survey, these points of information needed were those kept in mind.

After 600 of you fine people sent in your forms, they were coded and key-punched. Forms that dribbled in after that weren't included in the survey results.

To get the statistics I wanted from these forms I used SPSS, the Statistical Package for the Social Sciences, which was being implemented on the Columbia Teacher's College Burrough's 4700. SPSS is one of the most popular and widely used of the statistical packaged programs. It was originally developed as a batch system on IBM machines at

Stanford University around 1965. Since 1970, development has been progressing from the National Opinion Research Center at the University of Chicago. Its popularity among people whose work was founded on statistical analysis was instantaneous and I quickly discovered why. The program is simple to learn and it performs the kind of laborious statistics researchers would rather work from than figure out. Consequently, the package is now in use in over 1,000 installations in every state in the union and in over 50 foreign countries.

For the analysis I did of the *Creative Computing* Readership Survey I used only the simple frequency-display routines. The control cards to run the program required a control word in the control field found in columns 1 through 15 and the detailed instructions necessary for that task in the specification field in columns 16 through 80.

To get all the data necessary for the frequency of occurrence of each response to each question on the survey all that was necessary was a program that read:

```
RUN NAME       CREATIVE COMPUTING SURVEY
FILE NAME      GREEN
VARIABLE LIST  ID, CARD, ARTCLE, BKRREVS, FICTON, PUZZLE, LERNPR, GAMES, LETTER,
               ADS, EDITOR, CATLOG, CARTOUN, NOTICE, USEGAM, BLDCMP, MICROS,
               EDUCAT, MUSIC, ART, MEDCIN, SPACE, BUSNIS, HOMECT,
               GRPHIC, ARTINT, LEARN, FICTWT, SOCIMP, CLUBS, OTHER,
               TECNIC, CONFNC, JOB, CATWRK, CATSHL, CATHOM, CATOTH
               HMMICR, HMMINY, HMCRT, HMTERM, HMDISK, HMTAPR, HMVIDO, HMOT,
               REC, CAI, RESRCH, RECORD, CONTROL, WORK, CENTER, DISPLN,
               AGE, SCIFI, LIT, SPORTS, MYSTRY, HISTRY, ADVENT,
               ID2, CARD2, BYTE, ACM, COMPTMAG, CDEC, COMWORLD, CPR, DATAM,
               DOBBS, INTFACE, MATHTCH, MM, MININEWS, PCC, SCINEWS, SCIAMER,
               JOURNAL, READERS, SAVECOPY,COMPUTER, MINICOMP, MICCOMP, CHIPS,
               TERMINAL, TELE, GRATERM, COUPLER, PERIPH, PROGCAL, HANDCAL, LEAS,
               SOFTWARE, COURSE, LNAIDS, BUYBOOK, CONSULT, BUYOTH, COMMENT
PRINT BACK     YES
INPUT MEDIUM   CARD
N OF CASES     600
INPUT FORMAT   FIXED(F4.0,32F1.0,F2.0,27F1.0/F4.0,38F1.0)
MISSING VALUES ARTCLE TO ADVENT, BYTE TO COMMENT(9)
READ INPUT DATA
FREQUENCIES    GENERAL = ARTCLE TO ADVENT, BYTE TO COMMENT
```

From this the frequencies of occurrence of each response to each question on the survey were tabulated. The way for you to get the best understanding of the result of that tabulation is probably for us to reprint the questions as they appeared in the survey with the percentage recorded from boxes checked. The following represents what is read in an issue of *Creative Computing.*

1. In an issue of *Creative Computing,* the percentage of readers who read:

	Always	**Mostly**	**Sometimes**	**Never**
Feature Articles	43.8	46.4	9.6	0
Book Reviews	21.5	31.0	44.2	3.4
Fiction	34.3	25.5	31.4	8.8
Puzzles and Problems	35.8	31.2	28.5	4.4
Simulations and Learning Programs	37.7	37.4	22.0	2.7
Game Programs	48.8	26.0	21.3	3.7
Letters to the Editor	36.9	32.8	26.2	3.9
Editorials	37.4	38.3	21.3	2.9
Advertisements	35.8	39.2	24.2	0.8
Compleat Computer Catalogue	40.2	28.9	27.9	3.1
Cartoons, Humor	72.8	18.0	8.1	.8
Notices	36.7	36.7	25.0	1.4
2. I use the games or programs listed	4.8	20.8	53.9	20.6

Using the "always" percentage as a means of ranking the material that was read shows cartoons and humor leading the list, with game programs, feature articles, the compleat computer catalogue, simulation and learning programs, editorials, advertisements and puzzles and problems following in order of preference.

The wording of the questionnaire is vitally important to the analysis that results. The reader was given a choice in frequency of reading between 'always,' 'mostly' and 'sometimes,' guaranteeing that those who checked they 'always' read a type of article actually did, and that those types of articles would be given preferential treatment on getting into the next issue. Humor and cartoons offer a valuable perspective to examining computers in society, especially the computer in the home. This survey would dictate even more humor should get into this and other issues. I can also predict from this that *Creative Computing*'s new cartoon book, *The Colossal Computer Cartoon Book,* advertised in the catalog in the center of this issue, will be a smash success.

The fact that the advertisements are so highly read justified my belief that we all want to know as much as we can about what's available on the market, because so many of us want to get more equipment as soon as possible.

A more realistic assessment of overall readership for type of material, is one developed by ading the percentages of 'always' and 'mostly' read, and ranking the articles in that fashion. Using this cumulative percentage as the readership criteria, the material would be ranked as follows.

Ranking of material read in Creative Computing:	**Percentage of high readership:**
Cartoons, Humor	91%
Feature Articles	90
Editorials	76
Simulations and Learning Programs	75
Advertisements	75
Game Programs	75
Notices	74
Letters to the Editor	70
Compleat Computer Catalogue	69
Puzzles and Problems	67
Fiction	60
Book Reviews	52
2. I use the games or programs listed:	26

Of equal weight in not only selecting but soliciting material for *Creative Computing* will be the response you gave to what you would be interested in reading, which is:

SPSS-Statistical Package for the Social Sciences

For anyone who needs statistical calculations SPSS is highly recommended. Included in the growing list of analytic procedures it can perform are:

Frequency Display Routines
- a. FREQUENCY
- b. CROSSTABS

Non-parametric Statistcs
- a. Spearman/Kendall rank-order correlation routine

Analysis of Variance
- a. Analysis of Variance
- b. Analysis of Covariance
- c. Multivariate Analysis of Variance

Product Moment Correlation Coefficients
- a. Correlation
- b. Partial Correlation
- c. Regression

Miscellaneous
- a. T-Test
- b. Discriminant Analysis
- c. Guttman Sealing
- d. Transformations
- e. Weighting

Information can be obtained from SPSS, Inc., Suite 1234, 111 East Wacker Drive, Chicago, Ill. 60601 (312) 861-0933.

I would be interested in more articles about:	**Very Much**	**Some**	**Not Much**	**Waste of Space**
Building a Computer	41.4	32.9	22.6	2.9
Microcomputers	49.0	37.6	11.0	2.2
Computer use in Education	33.0	37.2	24.3	5.0
Music	27.3	27.2	35.8	9.7
Art/Graphics	39.2	36.8	20.9	3.1
Medicine	20.2	35.4	36.0	8.4
Space Exploration	35.8	37.2	21.6	5.0
Business and Industry	34.5	42.4	18.6	4.3
Home Control	49.6	33.0	15.0	2.2
Computer Graphics	52.8	34.1	12.0	1.0
Artificial Intelligence	58.6	27.1	12.5	1.5
Learning Activities	37.9	40.9	17.8	3.2
Fiction	22.9	35.3	28.6	13.1
Social Implications	21.4	41.0	28.4	9.2
Computer Club Activities	19.6	36.3	34.5	8.2
2. I would like more technical articles:	38.5	39.0	19.1	2.7
3. I would like more reprints from conference talks:	11.7	37.5	38.7	10.9

To find which material readers want to see in *Creative Computing*, high readership would be ranked by an accumulation of the percentages gotten for 'very much' and 'some.' Readership interest is:

Rank	**Interest in More Articles About:**	**High Readership Percentage**
1	Microcomputers	87
2	Computer Graphics	87
3	Artificial Intelligence	86
4	Home Control	83
5	Learning Activities	79
6	Technical Articles	78
7	Business and Industry	77
8	Art/Graphics	76
9	Space Exploration	73
10	Computer use in Education	71
11	Social Implications	62
12	Fiction	58
13	Computer Club Activities	57
14	Medicine	56
15	Music	55
16	Conference Reprints	50

It is of great interest to us that topping the list is the interest of our readers in microcomputers, computer graphics, and *artificial intelligence.* We have stated that the educational field and the hobby field are converging in interests with the advent of technology that makes the microcomputer affordable, widely accessible, and daily more versatile. Those of you who read John Lee's account of the Dynabook and Richard Vuillequez's account of the microcomputer's impact into technical education, in the May/June issue, can have little doubt that a future expansion of computers into all facets of education will come about with the microcomputer, as it never could, despite its promise, in the past. Therefore there is no surprise that those people who want to about "microcomputers" want to read about "artificial intelligence," usually associated with researchers and access to large computers and computer graphics.

As the power of affordable microcomputers increases, is it any wonder that hobbyists want to learn about artificial intelligence?

I talk about educators and hobbyists, but who are our readers? Since a percentage of you had more than one job I had to use the SPSS RECODE function and allow everyone only one job classification. With that done, you described yourself on the survey as:

Job Function	**Percentage**
Faculty: College or University	13.3
Faculty: Grades K-12	7.4
Student: College orUniversity	14.1
Student: Grades K-12	11.8
Industry:	35.5
Government:	6.1
Other	8.9

The great growth in *Creative Computing*'s readership has come from people in industry who are users of small computers at work, obviously interested in developing more ways to utilize that computer and having programs to run on it. Of the people who classified themselves as in industry, 94% have a computer at work and 36% have computers at home. These are people of dual interests: wanting more information both for their business systems, and for their new home computers.

These statistics were quickly obtained by using the CROSSTABS feature of SPSS. It tabulated the results of running JOB BY CATWK, CATHM, or the job function by whether the user has a computer at work and by whether he has a computer at home.

The frequency percentage for where a computer was utilized is:

I utilize a computer at (check all that apply):	**Percentage**
Work	69
School	47
Home	27
Other	6

Percentages for use of equipment, application, and school use are as follows:

At home I have (check all that apply):	**Percentage**
Microcomputer	18
Minicomputer	4
CRT Terminal	12
Hard Copy Terminal	14
Floppy Disk	5
Digital Cassette Tape	11
Video Display	8
Other	12
I Utilize my home computer for:	
Recreation	27
CAI	3
Research	14
Record Keeping	11
Home Control	4
Work Related	16

(If an education) I use a computer:

In a Computer Center 35

In My Discipline Which Is______________

The disciplines that were listed were coded and the the percentages of utilization by the disciplines are:

Discipline	Percentage Utilized
1. English	2
2. Math	6
3. Physics	2
4. Computer Science	5
5. Psychology	1
6. Education	2
7. Electronics	1
8. Other	7

The age of you readers is interesting. The great majority are between the ages of 21 and 35. The statistics show:

Age	Percent
Under 20	19.3
21-35	58.5
36-50	16.8
50 or over	3.3

What brought a great sigh of joy to yours truly, poring over the statistics in the middle of one dark, freezing night, after yet another long day, was to see that over 95% of you keep your issues of *Creative,* that many of you went so far as to circle the words *treasure it* on your forms. Sleepiness faded. The statistics read:

I save my copy:	Percentage
a week or two	.5
a month or two	3.4
keep it (file it, save it, treasure it)	95.8

We had been telling stores that stock the magazine that they didn't have to worry about returns, none of the material in *Creative Computing* is dated, and from everything we'd heard you readers kept your issues for future reference, use, etc. But over 95% of you readers keeping your copies is somewhat better than even I had envisioned, and a great morale booster. Thanks.

Also, more than 60% of the copies are read by more than one person, with over 17% read by four or more, which more than doubles the readership of our circulation. The statistics are:

How many people read this copy of Creative?	Percentage
One	39.1
Two	27.9
Three	15.4
more?	17.5

A lot of information about your interests can be ascertained by other literature you read so two questions asked you to check books and magazines you read, to which you responded:

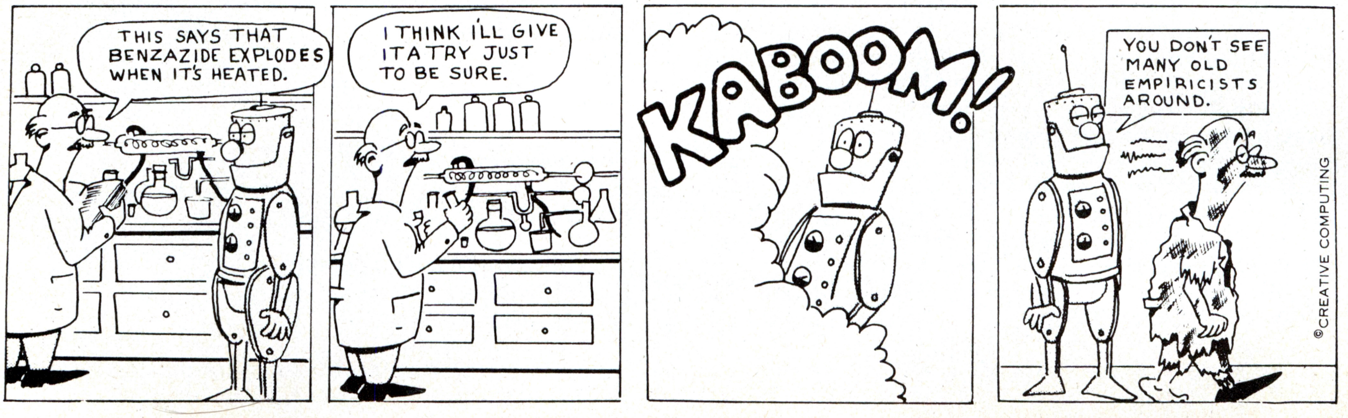
Books I read are (check all that apply):	Percentage
Science Fiction	70
Modern Literature	48
Sports	14
Mystery	32
History	35
Adventure	34

Other magazines I read are (Check all that apply):	
Byte	44
Communications of the ACM	25
Computer	13
Computer Decisions	34
Computerworld	40
Curriculum Product Review	2
Datamation	49
Dr. Dobb's Journal	12
Interface	24
The Mathematics Teacher	9
Mini Micro Systems	21
Minicomputer News	17
People's Computer Company	22
Science News	19
Scientific American	57
THE Journal	8

The highest percentage of you read science fiction over anything else listed, yet science fiction did not appear as a high priority of what you want to see more of in *Creative Computing.* Here is where some interpretation is necessary. I first ran a crosstabulation of fiction read in *Creative Computing* by want to read fiction in *Creative Computing.* Of those that like science-fiction books, 43% always read it in *Creative Computing,* 27% mostly read it, 26% sometimes read it and only 4% never read it. Of those that always read the fiction in *Creative Computing* only 53% want to see more of it very much, and of those that read it mostly only 18% want to see more of it very much. Yet over 70% of you readers are science fiction fans. I interpret. You are so anxious for more information in this rapidly growing field that although you like the stories and read them you are hesitant to have them take up space of "factual" material.

Yet although there are many good sources for science fiction, there is not enough that focus on the role the computer will have in shaping society and the interpersonal dynamics of people. It is good stuff to keep in mind as this technology advances on our life styles. It's its own kind of information. So, I think you want computer stories, but you don't want less information.

The only magazine that shares more than 50% of your readership is *Scientific American,* a magazine whose range of articles appeals to many. SPSS crosstabulations show that of those who are in industry, a field growing into the microcomputer age with dual work and personal interests,


THIS SAYS THAT BENZAZIDE EXPLODES WHEN IT'S HEATED.
I THINK I'LL GIVE IT A TRY JUST TO BE SURE.
KABOOM!
YOU DON'T SEE MANY OLD EMPIRICISTS AROUND.
©CREATIVE COMPUTING

only about 50% who read *Creative Computing* read any of the other magazines that are geared to the industrial computer user, *Computer Decisions, Computerworld, Datamation, Mini Micro Systems, Minicomputer News.* It should be of interest to an advertiser who wanted to sell to this active market of readers that by putting his ad anywhere else he would miss half of those *in industry* he reaches in *Creative Computing,* and many more in all the other disciplines.

It was most interesting to compare what job distinction signified about what equipment you buy or recommend for purchase. Although there were some job categories that listed a higher rate of selection of some items, because of a space restriction, I'll list the percentages of those in college faculty and those in industry that will buy the following items:

I recommend, specify, select or purchase: (check all that apply)	Percentage of Faculty:	Percentage of Industry:
Medium/large computer	25	27
Minicomputer	59	41
Microcomputer	46	37
MPU chips	20	18
CRT Terminal	65	51
Teleprinter	41	28
Graphics Terminal	43	25
Coupler/Data set	37	28
Peripherals	57	46
Programmable calculators	34	32
Hand calculators	38	28
Computer leasing service	20	11
Software	72	61
Courseware	37	10
Learning Aids	46	13
Books/Publications	74	48
Consultants	24	16

Creative Computing's readers have great power to buy or select an impressive array of computer equipment, a fact that is not surprising in the least, considering the mail that comes in, asking for advice and impartial reviews of equipment, but certainly indicates more equipment profile reviews are in order, and explains why the advertisements are so well read.

The survey can teach us that the computer hobbyist is not easily classified. Although 51% of the people who had microcomputers at home described their job function as industry, 11% were college faculty, 2% were high-school faculty, 5% were government workers, 11% were college students, 9% were high-school students, and 7% were in other fields.

As an example of the kind of specific information it is helpful to have and possible to get easily using SPSS, I asked for a crosstabulation of Job by Age by Micros, or job description, by age, by did you want to read more about microcomputers. For those people who wanted "very much" to read about microcomputers, the largest group was those in industry between the ages of 21-30. This was 29% of everybody who was divided into 48 groups. Of those who wanted "some" to read about microcomputers, the same group of people in industry between the ages of 21-30 had the lion's share, 31%. This group also comprised 19% of those who said that their interest was "not much" and 23% who said that such articles were "a wast of space."

This is a brief look at what can be gleaned from just who you are by the clues you left in those 41 boxes. Since I've discovered more questions I'd like to ask, next time you see a survey, fill it in. For those of you who kindly took the time, here it all is. Good likeness, eh? ■

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The author, a student at MIT, says he wanted to cover the "flavor" of the language, not write a reference manual.

A Taste of APL

Craig A. Finseth*

APL. What are those three letters that keep coming up, whispered in terminal rooms, barely audible under the sound of the Teletypes? Why do these letters keep coming up, even after they have been quashed for the *n*th time? And what could be in a language that would turn an otherwise ordinary programmer into something that has forgotten what a DIM statement is and doesn't even look at programs over ten lines long?

Let's start with its history, brief as it is. In the early 1960s, Dr. Kenneth E. Iverson published a book called *A Programming Language* (Wiley). This book described a new type of mathematical notation that would be self-consistent, in that instead of the current system in which different functions obey different syntactic rules (for example, 3×4 vs. tan 56) there would be one uniform rule. Each operation has its own character and appears as operator-argument or argument-operator-argument, depending upon whether it takes one or two arguments. (Subtraction takes two arguments while absolute value only needs one.) One character can have two different meanings depending upon context. Anyway, there it sat for awhile, until IBM came into the picture. It seems that they had put a computer into a research lab and it wasn't being used. They implemented a modified version of Iverson's notation and usage went up tremendously. In the first year, over 100,000 terminal hours were logged. The language eventually became APL\360 and APL has been expanding slowly ever since.

In APL, the workspace contains all function definitions, variable values, and anything else needed in order to run your programs. All of APL's built-in functions (usually called operators) are represented by single characters; user-defined functions have names just like variables. Anything that you type in is immediately evaluated from right to left. This means that running a program is actually just calling a function.

But enough talking for now! Let's go through a terminal session and see some of the details.

We want to start with a clear workspace (sort of erasing the blackboard), so we type in this:

```
      )CLEAR
CLEAR WS
```

(Your input is automatically indented six spaces by APL in order to distinguish it from the output). The ")" just means that it is a system command. Now, to find out what 3×4 is:

```
      3×4
12
```

As was mentioned, APL evaluates anything that you type in. To store the result and not print it, enter:

```
      A←3×4
```

The variable A should have the value 12. To print the value, just enter its name.

```
      A
12
```

At this point, it is worthwhile to note that APL uses "x" for multiplication and "÷" for division; "*" signifies exponentiation and "/" will be explained later.

In APL you can assign an array of numbers to a single variable. The numbers are separated by spaces. For example:

```
      A←1 2 3 6.7 9
      A
1 2 3 6.7 9
```

assigns the vector 1,2,3,6,7,9 to A. Now, whenever we refer to A, we are simultaneously referring to all of its elements. You can also get any individual element or group of elements by indexing.

```
      A[4]
6.7
      A[1 4 5]
1 6.7 9
```

For arrays of higher dimension, the indices are separated by semicolons. Unlike BASIC or FORTRAN, arrays are completely dynamic and can change in size or number of dimensions at any time. A way of creating arrays of higher dimension will be covered later. There is also the special case of a null array—a sort of representation of nothing. Just like the invention of zero, the null array has proven very useful. Now, since we won't be using A anymore, let's get rid of it.

```
      )ERASE A
```

And it is no more. Now, we shall define a function to generate all primes less than a given number. We will use the sieve of Eratosthenes to take all numbers less than n and drop the non-primes by checking for divisibility by the integers less than the square root of n. To start with, we specify a header giving a name and other information for the function.

---

*916 Ebony Ave., Duluth, MN 55811

```
        ∇R←PRIME B
[1]
```

The triangular character, called a del, tells APL that we want to open function definition. The variable R will be assigned the result, and the variable B is the one argument. APL responds by giving us a line number, inviting us to continue. We will start by giving I the value of 1. I will be our current divisor.

```
        I←1
[2]
```

And APL prompts us with another line number. Now, we assign R the vector from 2 to B. This means that R has the value of 2,3,4,5...B. The thing that looks like a mangled 2 is called iota and means to start with 1 and generate a vector of all the integers until you get to the number on the right. The down-arrow means drop. In this case, it drops 1 element (the first) from the vector on the right. (For explanation purposes, we will look at the case where B is 9—keep in mind that B is a variable.)

```
        R←1↓ιB
[3]
```

Note that we already know that one is defined as not prime. Remember that APL executes from right to left. Also, there is no heirarchy of operators, so that operations are done in the order they are encountered, except when they are within parentheses. Thus, in the example:

```
          5×7-3÷4+5
 33.33333333
```

APL add 4 and 5, divides 3 by this sum, subtracts this from 7, and multiplies by 5. To do this in BASIC or FORTRAN, you would have to do this:

5*(7 – 3/(4 + 5))   (*not* APL notation)

You might ask: why should APL do this differently than other languages? APL has many more operators than BASIC or FORTRAN, which only have five (+, –, *, /, **). This creates the problem of deciding which to do first. (Do you do factorials before or after arcsin?) Iverson solved this problem by deciding that APL should have no heirachy.

Let's continue with our function.

```
        LOOP: R←((I=R)≥0=(I←I+1)|R)/R
[4]
```

No, don't go away, this mess has meaning. We'll start on the inside parentheses, keeping in mind that the /R is "hung," waiting for the stuff inside the parentheses to finish.

```
          (I←I+1)
```

This just increments I by 1.

```
          (I←I+1)|R
```

The vertical bar means, for positive arguments, the remainder of an integer division of the left argument into the right. Some examples:

```
          5|12
2
          3|6
0
```

It should be pointed out that if you have a single number on one side of an operator, and an array on the other, the scalar will be expanded to match the array in size. Thus, the scalar I and the vector R can be processed by the vertical bar.

In APL the six relational operators produce results based on the truth of the relation, where one stands for true and zero for false. So 3 = 4 would produce zero while 5 = 5 would produce a one. Combining this with scalar extension makes sense out of the "0 = (I...." Whenever the result of the vertical bar is not zero, the result of the equals operator is zero and whenever the result of the vertical bar is zero, the result of the equals is one. The net effect is to produce a zero whenever I divides evenly into a given element of R, otherwise a one.

We have to be sure that an element is not lost because I is equal to it. So we have the I = R set a one where I is equal to a given element of R; everything else is zero. The greater-than-or-equal-to sets every element in the result to one, except where I≠R and the vertical bar has a zero remainder. The following diagram shows the intermediate results (each starts below the operator that generates it, with the lower levels being generated later).

```
((I=R)≥0=(I←I+1)|R)
            2     2 3 4 5 6 7 8 9
                 0 1 0 1 0 1 0 1
         1 0 1 0 1 0 1 0
 2   2 3 4 5 6 7 8 9      VARIABLE
    1 0 0 0 0 0 0 0        VALUES
       1 1 0 1 0 1 0 1
```

Now, after all that, we have a vector of zeros and ones—why do we want it? Well, remember the /R on the end? The whole line is:

```
[3]     LOOP: R←((I=R)≥0=(I←I+1)|R)/R
```

At last, the explanation of /. Let's say that we have 1 0 1/3 4 5. This will result in 3 5. Wherever there was a one, the element is kept and if it was zero, the element is dropped. Thus, our 1 1 0 1 0 1 0 1/2 3 4 5 6 7 8 9 results in 2 3 5 7 9—the multiples of two have been dropped completely! This result vector is assigned into R and the statement is finished. (LOOP is a statement label, a variable that contains the statement number of the line that it is on (i.e., 3).)

Now, for the last line.

```
          →LOOP IF I<B*0.5
[5]       ∇
```

This goes to the line number given by LOOP if I is less than the square root of B. Line five has a del in order to close function definition.

Let's execute the function and see what happens.

```
        ANSWER←PRIME 9
  SYNTAX ERROR
  PRIME[4]    →LOOP IF I<B*0.5
                     ^
```

What happened? We made a mistake. APL printed the message, the errant line, and a carat pointing to where it blew up. It turns out that we forgot to define a function IF. Keep in mind that only operators are predefined. In general, if it has a name we have to define it ourselves. So:

```
          ∇R←A IF B
[1]       R←B/A
[2]       ∇
```

In this function, R will be assigned the value of A if B is true (one) or else null (here's one of its many uses). It can get the null value because that's what's left if you remove everything from A via the "/" by having a false (zero) value for B.

APL keeps each function separate, so all line numberings begin with 1,2,3... Now, we can pick up where we left off by doing:

```
→4
```

in which APL goes to line 4 of the most recently suspended function. (Most often, functions are suspended by errors.) Since there is only one suspended function, APL goes to line 4 of PRIME.

Now, it just prints a linefeed. To find the answer enter:

```
      ANSWER
2 3 5 7
```

One of the nice things about APL is that if you wish to do something that is not a defined operator, or just do something in a different way, you can define a function to do it. Also, by writing the proper functions, you can readily model almost any other language in APL.

One final note about the right-arrow. It causes APL to go to the indicated line number. If the line is not there (say, line zero) the function will stop. If it is a null value, APL just goes on to the next line.

We mentioned that APL can handle arrays of any dimension, but was not said how to create them. To generate a 2-by-3 array of zeros you do this:

```
A_MATRIX←2 3ρ0 0 0 0 0 0
```

or

```
A_MATRIX←2 3ρ0
```

(Remember scalar extention). Now the variable A MATRIX has a shape of 2 × 3). This means that it has two rows and three columns.

```
      A_MATRIX

0 0 0
0 0 0

      ρA_MATRIX
2 3
```

Using just one argument with that funny-looking p (called rho) gives the shape (the length of each dimension) as a result.

Suppose that you want to find the location of a value in a vector. For variety, we'll use characters, which are treated just like numbers and stored one character per element. Anyhow, we want to use the two-argument form of iota.

```
      'ABCD'ι'C'
3
```

'C' is, of course, the third element in 'ABCD'

APL can also meld two items into one. For this, the concatenate operator (comma) is used.

```
      FIRST←2 3ρ'ABCDEF'
      SECOND←2 4ρ'GHIJKLMN'
      FIRST

ABC
DEF
      SECOND

GHIJ
KLMN
      BOTH←FIRST,SECOND
      BOTH

ABCGHIJ
DEFKLMN
      ρBOTH
2 7
```

APL can also transpose a matrix (switch its dimensions)

```
      ARRAY←2 3ρι6
      ARRAY

1 2 3
4 5 6
      ρARRAY
2 3
      TRANS←⍉ARRAY
      TRANS

1 4
2 5
3 6
      ρTRANS
3 2
```

And, to reverse an array (flip it right-to-left) do:

```
      REV←⌽ARRAY
      REV

3 2 1
6 5 4
      ρREV
2 3
```

You can also rotate an array any amount.

```
      ROT←1⌽ARRAY
      ROT

2 3 1
5 6 4
```

Here, ARRAY has been rotated one element to the left. It should be noted that APL allows names of almost any length. They have been kept short for convenience.

There are a number of functions that will just be mentioned before we move on. APL supports the logarithm and exponential functions, trig functions (sine, cosine, and tangent) and their inverses, the hyperbolic functions, pseudo-random number generation, sorting, the logical functions (and, or etc.), matrix division, generalized inner and outer product, generalized summation and generalized cumulative sum. Generalized means that any function that takes two arguments can be used instead of just plus or times.

Two more things before we move on to input and output. Negation (−) (the one-argument form) means to take what is on the right and change its sign. Negative (¯) means that a number is negative. Thus, −3+4 means ¯7 while ¯3+ 4 means 1. Also, if A is a variable then – A is legal while ¯A is not.

APL has two operators that handle input and output. They are:

```
QUAD:  ⎕        AND      QUOTE-QUAD:  ⍞
```

For output, just assign into quad.

```
        A←3
        ⎕←A
3
        A
3
```

For input, just assign from quad.

```
        A←⎕
⎕:
```

APL then waits for you to enter any expression. This will be evaluated and assigned into A. So we type:

```
        7-10
        A
¯3
```

This can cause problems, especially for instructors who are writing drill-and-practice programs. When they type "WHAT IS 11 × 5?" as the answer. Instead, they can use quote-quad for input. Quote-quad just takes the input and stores it as characters. A sample line might look like this:

```
VALUE←⍎(INPUT∊'0123456789')/INPUT←⍞
```

First, the input characters are stored in INPUT. Then, that fishy-looking e (called epsilon) produces a one whenever a character on the left is in the array on the right. Thus, only where the student entered a digit will there be a one. The slash then deletes everything but digit characters. That odd-looking thing, just to the left of the "(", takes the character vector on the right and treats it like an APL expression. This VALUE has the numeric value of the character vector, which itself has had everything but valid numeric characters deleted.

One final example, and I'll leave you to your hundred-line BASIC programs (you should be able to see by now that a little APL can do a lot).

Let's define a function CHANGE which will print the number of half-dollars, quarters, dimes, nickels, and pennies to be returned from a purchase.

```
        ∇CHANGE
[1]     0 2 2.5 2 5⊤100-⎕
[2]     ∇
```

This function doesn't return a value or require an argument, so all that's on the header line is its name. The one and only line subtracts the input (via the quad) from 100 and then proceeds to apply the represent operator (it looks like a t) to that value. Represent multiplies all the elements together and sees how many times that goes in, then places this in the first element of the result. It repeats this with the all-but-first elements, then the all-but-first-and-second, etc., storing the quotients in successive elements of the result. Let's run an example.

```
        CHANGE
⎕:
        17
1  1  0  1  3
```

This says that there is one half-dollar, one quarter, no dimes, one nickel, and three pennies in 83¢.

Let's see which functions we have defined and list them.

```
        )FNS
CHANGE   IF          PRIME

        ∇CHANGE[⎕]∇
     ∇  CHANGE
[1]     0  2  2.5  2  5⊤100-⎕
     ∇

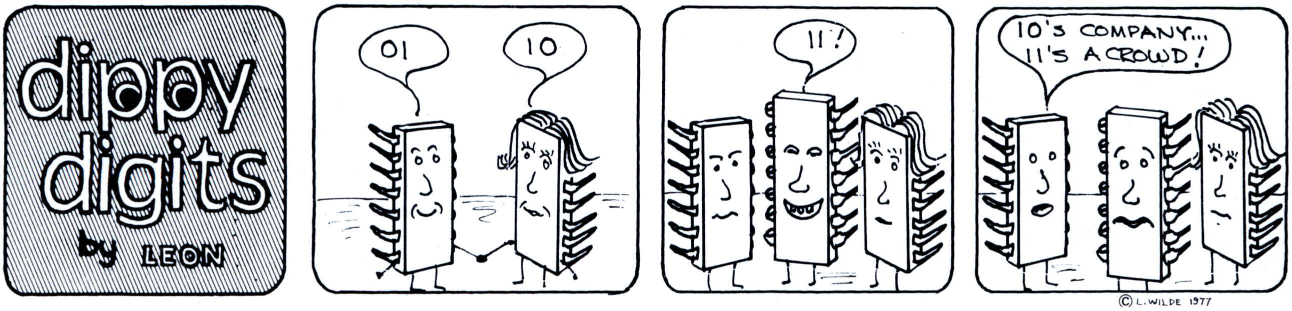

        ∇PRIME[⎕]∇
     ∇  R←PRIME B
[1]     I←1
[2]     R←1↓⍳B
[3]    LOOP: R←((I=R)≥0=(I←I+1)|R)/R
[4]     →LOOP IF I<B*0.5
     ∇


        ∇IF[⎕]∇
     ∇  R←A IF B
[1]     R←B/A
     ∇
```

In summary, APL is a concise, powerful language with applications in many areas. It is built upon arrays and user-defined functions, thus it is amazingly flexible and versatile.

This is only intended to give the "flavor" of APL. The best way to learn the language is to get a manual and sit at a terminal, experimenting.

Funds for examples provided by the Student Information Processing Board of the Massachusetts Institute of Technology. ■



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Psychoanlysis (?) by Computer...

ELIZA

Steve North

Language: BASIC (MITS 8K)

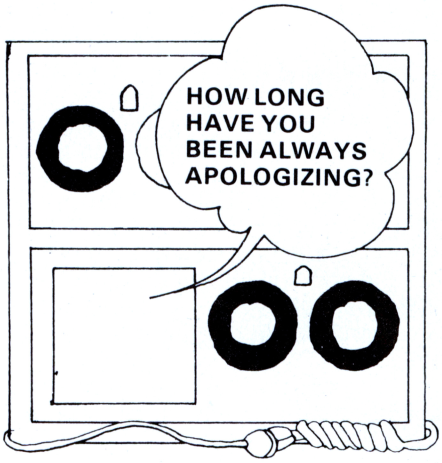
Author: Originally programmed in LISP by Joseph Weizenbaum. This version is based on one written by Jeff Shrager.

Description: ELIZA is a program that accepts natural English as input and carries on a reasonably coherent conversation based on the psychoanalytic techniques of Carl Rogers. You will have to forgive ELIZA for being a poor English student. You'll find that it is best not to use punctuation in your input, and you'll have to carry the conversation. But it does work!

Remarks: In order to do what it does, ELIZA must: (1) get a string from the user, and prepare it for further processing: (2) find the keywords in the input string: (3) if a keyword is found, take the part of the string following the keyword and "translate" all the personal pronouns and verbs ("I" becomes "YOU", "ARE" becomes "AM", etc.); (4) finally, look up an appropriate reply based on the keyword which was found, print it and, if necessary, the "translated" string. ELIZA uses four types of program data to accomplish this:
(1) 36 keyword, such as "I AM", "WHY DONT YOU", and "COMPUTER". The keywords must be in order of priority, so ELIZA will key on "YOU ARE" before "YOU".
(2) 12 strings used for the translation or conjugation process. These are in pairs

Sample Run

```
RUN
HI!  I'M ELIZA.  WHAT'S YOUR PROBLEM?
? I AM AN IBM 370
DID YOU COME TO ME BECAUSE YOU ARE AN IBM 370
? YES I WANT A NEW LINEPRINTER
WHAT WOULD IT MEAN TO YOU IF YOU GOT A NEW LINEPRINTER
? ABOUT 1200 LPM
SAY, DO YOU HAVE ANY PSYCHOLOGICAL PROBLEMS?
? WHAT WOULD YOU KNOW I'M A 370 AND YOU'RE AN IMSAI
WHAT MAKES YOU THINK I AM AN IMSAI
? IT SAYS THAT ON YOUR FRONT PANEL
WHY ARE YOU CONCERNED ABOUT MY FRONT PANEL
? LOOK YOU BROUGHT UP THE SUBJECT
WE WERE DISCUSSING YOU-- NOT ME.
? I'M FIXING A HOLE...
DID YOU COME TO ME BECAUSE YOU ARE FIXING A HOLE...
? SORRY THAT WAS A TEN YEAR OLD SOFTWARE BUG
PLEASE DON'T APOLOGIZE!
? I AM ALWAYS APOLOGIZING
HOW LONG HAVE YOU BEEN ALWAYS APOLOGIZING
? SINCE MY FIRST COLD START
WHAT DOES THAT SUGGEST TO YOU?
? YOU'RE THE SHRINK
DOES IT PLEASE YOU TO BELIEVE I AM THE SHRINK
? DONT YOU KNOW?
OH, I KNOW?
? I AM BEGINNING TO WONDER ABOUT YOU
DO YOU BELIEVE IT IS NORMAL TO BE BEGINNING TO WONDER ABOUT I
? HA HA HA YOU CAN'T EVEN TALK PROPERLY
YOU'RE NOT REALLY TALKING ABOUT ME, ARE YOU?
? IS THERE ANYONE ELSE IN THE ROOM?
I SEE.
? COMPUTERS DONT HAVE EYES
ARE YOU SURE?
? ABOUT COMPUTERS?
DO COMPUTERS WORRY YOU?
? SHOULD THEY AFTER ALL I AM A 370
DO YOU ENJOY BEING A 370
?
```


HOW LONG HAVE YOU BEEN ALWAYS APOLOGIZING?

Program Listing

```
10 REM
20 REM       ELIZA/DOCTOR
30 REM       CREATED BY JOSEPH WEIZENBAUM
40 REM       THIS VERSION BY JEFF SHRAGER
50 REM       EDITIED AND MODIFIED FOR MITS 8K BASIC 4.0 BY STEVE NORTH
60 REM       CREATIVE COMPUTING PO BOX 789-M MORRISTOWN NJ 07960
70 REM
80 REM       -----INITIALIZATION-----
90 DIM C$(72),I$(72),K$(72),F$(72),S$(72),R$(72),P$(72),Z$(72)
100 DIM S(36),R(36),N(36)
110 N1=36:N2=12:N3=112
120 FOR X=1 TO N1+N2+N3:READ Z$:NEXT X:REM SAME AS RESTORE
130 FORX=1 TO N1
140 READ S(X),L:R(X)=S(X):N(X)=S(X)+L-1
150 NEXT X
160 PRINT "HI!  I'M ELIZA.  WHAT'S YOUR PROBLEM?"
170 REM
180 REM       -----USER INPUT SECTION-----
190 REM
200 INPUT I$
201 I$=" "+I$+"  "
210 REM  GET RID OF APOSTROPHES
220 FOR L=1 TO LEN(I$)
230 IFMID$(I$,L,1)="'"THENI$=LEFT$(I$,L-1)+RIGHT$(I$,LEN(I$)-L):GOTO230
240 IFL+4<=LEN(I$)THENIFMID$(I$,L,4)="SHUT"THENPRINT"SHUT UP...":END
```

such that if one member of the pair is found, the other is substituted for it. Examples: "Y", "YOU", "AM", "ARE", etc.

(3) 112 reply strings. The strings are arranged in groups corresponding to the keywords. There is no fixed number of different replies for each keyword. Replies ending in a "*" are to be followed by the translated string, while the strings ending in normal punctuation are to be printed alone.

(4) Numerical data to determine which replies to print for each keyword. For each keyword there is a pair of numbers signifying (start of reply strings, number of reply strings). Thus the fifth pair of number, (10,4), means that the replies for the fifth keyword ("I DONT") start with the tenth reply string, and that there are four replies.

Detailed Explanation:

Lines 10-160: Initialization. Arrays and strings are dimensioned. N1, N2, and N3, which represent the number of keywords, number of translation strings, and number of replies respectively, are defined. Then the arrays are filled. S(keyword number) is the ordinal number of the start of the reply strings for a given keyword, R(keyword number) is the actual reply to be used next, and N(keyword number) is the last reply for that keyword. Finally an introduction is printed.

Lines 170-255: User input section. This part of the program gets a string from the user, places a space at the start of the string and two at the end (to make it easier to correctly locate keywords and to preventsubscripting out of bounds), throws out all the apostrophes (so DONT and DON'T are equivalent), and stops if the word SHUT is found in the input string (which it takes to mean SHUT UP). ELIZA also checks for repetitive input by the user.

Lines 260-370: Keyword-finding section. ELIZA scans the input string for keywords and saves the keyword of highest priority temporarily in S, T, and F$. If no keyword is found, the keyword defaults to number 36, NOKEYFOUND (which causes ELIZA to say something noncommital) and it skips the next section.

Lines 380-555: Translation or Conjugation section. The part of the input string following the keyword is saved. Then pairs of translation strings, as described above, are read and upon the occurence of one of these strings, the other is substituted for it. When this is done ELIZA makes sure there is only one leading space in the translated string.

Lines 560-640: Reply printing section. Using R(keyword number), S(keyword number), and N(keyword number), the correct reply is located. The pointer for the next reply is bumped and reset if it is

```
250 NEXT L
255 IF I$=P$ THEN PRINT "PLEASE DON'T REPEAT YOURSELF!":GOTO 170
260 REM
270 REM     -----FIND KEYWORD IN I$-----
280 REM
290 RESTORE
295 S=0
300 FOR K=1 TO N1
310 READ K$
315 IF S>0 THEN360
320 FOR L=1 TO LEN(I$)-LEN(K$)+1
340 IF MID$(I$,L,LEN(K$))=K$THENS=K:T=L:F$=K$
350 NEXT L
360 NEXT K
365 IF S>0 THEN K=S:L=T:GOTO390
370 K=36:GOTO570:REM  WE DIDN'T FIND ANY KEYWORDS
380 REM
390 REM     TAKE RIGHT PART OF STRING AND CONJUGATE IT
400 REM     USING THE LIST OF STRINGS TO BE SWAPPED
410 REM
420 RESTORE:FORX=1 TO N1:READ Z$:NEXT X:REM SKIP OVER KEYWORDS
430 C$=" "+RIGHT$(I$,LEN(I$)-LEN(F$)-L+1)
440 FOR X=1 TO N2/2
450 READ S$,R$
460 FOR L= 1 TO LEN(C$)
470 IF L+LEN(S$)>LEN(C$) THEN 510
480 IF MID$(C$,L,LEN(S$))<>S$ THEN 510
490 C$=LEFT$(C$,L-1)+R$+RIGHT$(C$,LEN(C$)-L-LEN(S$)+1)
495 L=L+LEN(R$)
500 GOTO 540
510 IF L+LEN(R$)>LEN(C$)THEN540
520 IF MID$(C$,L,LEN(R$))<>R$ THEN 540
530 C$=LEFT$(C$,L-1)+S$+RIGHT$(C$,LEN(C$)-L-LEN(R$)+1)
535 L=L+LEN(S$)
540 NEXT L
550 NEXT X
555 IF MID$(C$,2,1)=" "THENC$=RIGHT$(C$,LEN(C$)-1):REM ONLY 1 SPACE
560 REM
570 REM     NOW USING THE KEYWORD NUMBER (K) GET REPLY
580 REM
590 RESTORE:FOR X= 1 TO N1+N2:READ Z$:NEXT X
600 FORX=1TOR(K):READ F$:NEXT X:REM  READ RIGHT REPLY
610 R(K)=R(K)+1: IFR(K)>N(K) THEN R(K)=S(K)
620 IF RIGHT$(F$,1)<>"*" THEN PRINT F$:P$=I$:GOTO 170
630 PRINT LEFT$(F$,LEN(F$)-1);C$
640 P$=I$:GOTO 170
1000 REM
1010 REM     -----PROGRAM DATA FOLLOWS-----
1020 REM
1030 REM     KEYWORDS
1040 REM
1050 DATA "CAN YOU","CAN I","YOU ARE","YOURE","I DONT","I FEEL"
1060 DATA "WHY DONT YOU","WHY CANT I","ARE YOU","I CANT","I AM","IM "
1070 DATA "YOU ","I WANT","WHAT","HOW","WHO","WHERE","WHEN","WHY"
1080 DATA "NAME","CAUSE","SORRY","DREAM","HELLO","HI ","MAYBE"
1090 DATA " NO","YOUR","ALWAYS","THINK","ALIKE","YES","FRIEND"
1100 DATA "COMPUTER","NOKEYFOUND"
1200 REM
1210 REM     STRING DATA FOR CONJUGATIONS
1220 REM
1230 DATA " ARE "," AM ","WERE ","WAS "," YOU "," I ","YOUR ","MY "
1235 DATA " IVE "," YOUVE "," IM "," YOURE "
1300 REM
1310 REM     REPLIES
1320 REM
1330 DATA "DON'T YOU BELIEVE THAT I CAN*"
1340 DATA "PERHAPS YOU WOULD LIKE TO BE ABLE TO*"
1350 DATA "YOU WANT ME TO BE ABLE TO*"
1360 DATA "PERHAPS YOU DON'T WANT TO*"
1365 DATA "DO YOU WANT TO BE ABLE TO*"
1370 DATA "WHAT MAKES YOU THINK I AM*"
1380 DATA "DOES IT PLEASE YOU TO BELIEVE I AM*"
1390 DATA "PERHAPS YOU WOULD LIKE TO BE*"
1400 DATA "DO YOU SOMETIMES WISH YOU WERE*"
1410 DATA "DON'T YOU REALLY*"
1420 DATA "WHY DON'T YOU*"
1430 DATA "DO YOU WISH TO BE ABLE TO*"
1440 DATA "DOES THAT TROUBLE YOU?"
1450 DATA "TELL ME MORE ABOUT SUCH FEELINGS."
1460 DATA "DO YOU OFTEN FEEL*"
1470 DATA "DO YOU ENJOY FEELING*"
1480 DATA "DO YOU REALLY BELIEVE I DON'T*"
1490 DATA "PERHAPS IN GOOD TIME I WILL*"
1500 DATA "DO YOU WANT ME TO*"
1510 DATA "DO YOU THINK YOU SHOULD BE ABLE TO*"
1520 DATA "WHY CAN'T YOU*"
1530 DATA "WHY ARE YOU INTERESTED IN WHETHER OR NOT I AM*"
1540 DATA "WOULD YOU PREFER IF I WERE NOT*"
1550 DATA "PERHAPS IN YOUR FANTASIES I AM*"
```

too large. If the reply string ends in a "*" it is printed with the translated string, otherwise it is printed alone. The previously entered input string is saved to permit checking for repetetive input, and then ELIZA goes back for more input.

Limitations: Runs in 16K of memory.

Modifications: You can easily add, change, or delete any of the keywords, translation words, or replies. Remember, you will also have to change N1, N2, N3, and/or the numerical data. Just as a suggestion, if you decide to insert "ME" and "YOU" in the translation string list, put a nonprinting (control) character in YOU to prevent ELIZA from substituting I→YOU→ME. This means that YOU will always be assumed to be the subject of a verb, never the object, but resolving that difficulty is a whole different problem.

A Few Comments: The structures found in lines 120, 420, and 590 could be replaced by RESTORE NNNN statements if your BASIC has them. The use of an INSTR, SEARCH, or POS function to determine if one string is a substring of another would probably speed things up considerably (it takes ELIZA around 10 seconds to think of a reply).

What it all means: we'll leave to you. Although this program is an inferior imitation of the original, it does work. It is pretty farfetched to believe that a psycholanalyst is nothing but a sentence-input-keyword-finder-conjugator-reply finder, but if you really think so, you can buy your computer a speech-recognition unit, a Computalker and a green couch, and charge $75/hr! My computer, the doctor!

MITS STRING BASIC FUNCTIONS

LEFT$ (X$,X) takes the X leftmost characters of X$.

RIGHT$(X$,X) takes the X rightmost characters of X$.

MID$ (X$,X,Y) takes Y characters from X$ starting with the Xth character.

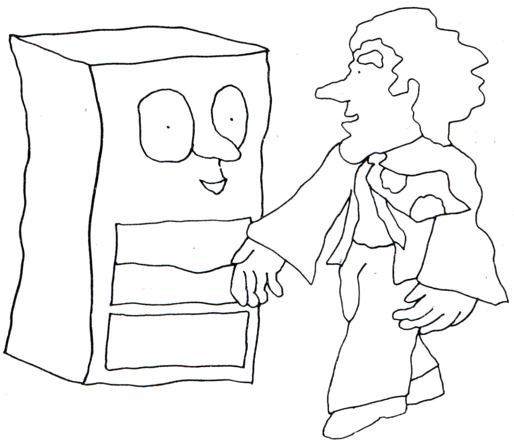
DIM X$ (72) dimensions X$ to hold 72 characters. That may seem obvious, but there's a story that goes along with this. The listing of ELIZA was made on a friend's SWTPC 6800 running 8K BASIC. After making a small patch in BASIC, loading a paper tape, and changing all the multiple statements to separate lines, we were all ready to try out ELIZA when Bob (whose computer it was asked about the enormous strings ELIZA used. It turns out that in SWTPC BASIC, DIM X$(72) means dimension string vector X$ to have 72 little strings (X$(K)) of 18 character

```
1560 DATA "HOW DO YOU KNOW YOU CAN'T*"
1570 DATA "HAVE YOU TRIED?"
1580 DATA "PERHAPS YOU CAN NOW*"
1590 DATA "DID YOU COME TO ME BECAUSE YOU ARE*"
1600 DATA "HOW LONG HAVE YOU BEEN*"
1610 DATA "DO YOU BELIEVE IT IS NORMAL TO BE*"
1620 DATA "DO YOU ENJOY BEING*"
1630 DATA "WE WERE DISCUSSING YOU-- NOT ME."
1640 DATA "OH, I*"
1650 DATA "YOU'RE NOT REALLY TALKING ABOUT ME, ARE YOU?"
1660 DATA "WHAT WOULD IT MEAN TO YOU IF YOU GOT*"
1670 DATA "WHY DO YOU WANT*"
1680 DATA "SUPPOSE YOU SOON GOT*"
1690 DATA "WHAT IF YOU NEVER GOT*"
1700 DATA "I SOMETIMES ALSO WANT*"
1710 DATA "WHY DO YOU ASK?"
1720 DATA "DOES THAT QUESTION INTEREST YOU?"
1730 DATA "WHAT ANSWER WOULD PLEASE YOU THE MOST?"
1740 DATA "WHAT DO YOU THINK?"
1750 DATA "ARE SUCH QUESTIONS ON YOUR MIND OFTEN?"
1760 DATA "WHAT IS IT THAT YOU REALLY WANT TO KNOW?"
1770 DATA "HAVE YOU ASKED ANYONE ELSE?"
1780 DATA "HAVE YOU ASKED SUCH QUESTIONS BEFORE?"
1790 DATA "WHAT ELSE COMES TO MIND WHEN YOU ASK THAT?"
1800 DATA "NAMES DON'T INTEREST ME."
1810 DATA "I DON'T CARE ABOUT NAMES-- PLEASE GO ON."
1820 DATA "IS THAT THE REAL REASON?"
1830 DATA "DON'T ANY OTHER REASONS COME TO MIND?"
1840 DATA "DOES THAT REASON EXPLAIN ANYTHING ELSE?"
1850 DATA "WHAT OTHER REASONS MIGHT THERE BE?"
1860 DATA "PLEASE DON'T APOLOGIZE!"
1870 DATA "APOLOGIES ARE NOT NECESSARY."
1880 DATA "WHAT FEELINGS DO YOU HAVE WHEN YOU APOLOGIZE."
1890 DATA "DON'T BE SO DEFENSIVE!"
1900 DATA "WHAT DOES THAT DREAM SUGGEST TO YOU?"
1910 DATA "DO YOU DREAM OFTEN?"
1920 DATA "WHAT PERSONS APPEAR IN YOUR DREAMS?"
1930 DATA "ARE YOU DISTURBED BY YOUR DREAMS?"
1940 DATA "HOW DO YOU DO ... PLEASE STATE YOUR PROBLEM."
1950 DATA "YOU DON'T SEEM QUITE CERTAIN."
1960 DATA "WHY THE UNCERTAIN TONE?"
1970 DATA "CAN'T YOU BE MORE POSITIVE?"
1980 DATA "YOU AREN'T SURE?"
1990 DATA "DON'T YOU KNOW?"
2000 DATA "ARE YOU SAYING NO JUST TO BE NEGATIVE?"
2010 DATA "YOU ARE BEING A BIT NEGATIVE."
2020 DATA "WHY NOT?"
2030 DATA "ARE YOU SURE?"
2040 DATA "WHY NO?"
2050 DATA "WHY ARE YOU CONCERNED ABOUT MY*"
2060 DATA "WHAT ABOUT YOUR OWN*"
2070 DATA "CAN YOU THINK OF A SPECIFIC EXAMPLE?"
2080 DATA "WHEN?"
2090 DATA "WHAT ARE YOU THINKING OF?"
2100 DATA "REALLY, ALWAYS?"
2110 DATA "DO YOU REALLY THINK SO?"
2120 DATA "BUT YOU ARE NOT SURE YOU*"
2130 DATA "DO YOU DOUBT YOU*"
2140 DATA "IN WHAT WAY?"
2150 DATA "WHAT RESEMBLANCE DO YOU SEE?"
2160 DATA "WHAT DOES THE SIMILARITY SUGGEST TO YOU?"
2170 DATA "WHAT OTHER CONNECTIONS DO YOU SEE?"
2180 DATA "COULD THERE REALLY BE SOME CONNECTION?"
2190 DATA "HOW?"
2200 DATA "YOU SEEM QUITE POSITIVE."
2210 DATA "ARE YOU SURE?"
2220 DATA "I SEE."
2230 DATA "I UNDERSTAND."
2240 DATA "WHY DO YOU BRING UP THE TOPIC OF FRIENDS?"
2250 DATA "DO YOUR FRIENDS WORRY YOU?"
2260 DATA "DO YOUR FRIENDS PICK ON YOU?"
2270 DATA "ARE YOU SURE YOU HAVE ANY FRIENDS?"
2280 DATA "DO YOU IMPOSE ON YOUR FRIENDS?"
2290 DATA "PERHAPS YOUR LOVE FOR FRIENDS WORRIES YOU."
2300 DATA "DO COMPUTERS WORRY YOU?"
2310 DATA "ARE YOU TALKING ABOUT ME IN PARTICULAR?"
2320 DATA "ARE YOU FRIGHTENED BY MACHINES?"
2330 DATA "WHY DO YOU MENTION COMPUTERS?"
2340 DATA "WHAT DO YOU THINK MACHINES HAVE TO DO WITH YOUR PROBLEM?"
2350 DATA "DON'T YOU THINK COMPUTERS CAN HELP PEOPLE?"
2360 DATA "WHAT IS IT ABOUT MACHINES THAT WORRIES YOU?"
2370 DATA "SAY, DO YOU HAVE ANY PSYCHOLOGICAL PROBLEMS?"
2380 DATA "WHAT DOES THAT SUGGEST TO YOU?"
2390 DATA "I SEE."
2400 DATA "I'M NOT SURE I UNDERSTAND YOU FULLY."
2410 DATA "COME COME ELUCIDATE YOUR THOUGHTS."
2420 DATA "CAN YOU ELABORATE ON THAT?"
2430 DATA "THAT IS QUITE INTERESTING."
2500 REM
```

each. There's no easy way to handle more than 18 characters at a time! Those of you using SWTPC 6800 BASIC should have a lot of fun with this.

```
2510 REM      DATA FOR FINDING RIGHT REPLIES
2520 REM
2530 DATA 1,3,4,2,6,4,6,4,10,4,14,3,17,3,20,2,22,3,25,3
2540 DATA 28,4,28,4,32,3,35,5,40,9,40,9,40,9,40,9,40,9,40,9
2550 DATA 49,2,51,4,55,4,59,4,63,1,63,1,64,5,69,5,74,2,76,4
2560 DATA 80,3,83,7,90,3,93,6,99,7,106,6
```

Name	*Usage*
R(X),S(X),N(X)	See Text
I$	Input string
K$	Keyword string
C$	Translated or conjugated string
F$	Reply string, also used to save K$ in scanning for keyword
R$,S$	Strings used in conjugation process
P$	Previous input string
Z$	Scratch (used for simulating RESTORE NNNN statement).
N1	Number of keywords
N2	Number of conjugation strings
N3	Number of replies
K	Keyword number
S,T	Used to save K and L when scanning for keyword
X,L	X,L Scratch. X is generally used for looping while L is used for scanning through strings
V	V Used for scanning for keyword string



DATA PROCESSING DEFINITIONS

ASSUMED DECIMAL POINT. Located two positions to the right of a programmer's current salary in estimating his own worth.

BIT. The increment by which programmers slowly go mad.

CHAINING. A method of attaching programmers to desks to speed up output.

CHECKPOINT. The location from which a programmer draws his salary.

COMMON LANGUAGE. The first thing a programmer must forget in order to be successful.

CORE STORAGE. A receptacle for the center section of apples.

COUNTER. A device over which martinis are served.

ERROR. What someone else has made when he disagrees with your computer output.

EXTERNAL STORAGE. Wastebasket.

FIXED WORD LENGTH. Four-letter words used by programmers in a state of confusion.

FLOATING CONTROL. A characteristic exhibited when you have to go to the restroom but can't leave the computer.

FLOATING POINT. The absolute limit before floating control is lost.

FLOW CHART. A graphic representation of the fastest route to the restroom.

INPUT. Food, whiskey, beer, aspirin, etc.

MACRO. The last half of an expression of surprise: "Holy Macro."

MEMORY DUMP. Amnesia.

PROGRAMMER. Red-eyed, mumbling mammal capable of conversing with inanimate objects.

—Modern Data

The COMPUTALKER Model CT-1 optimizes the trade-off between low data rate speech and directly digitized speech. Low data rate speech relies on canned definitions for the sound of each phoneme, which produces mechanical sounding speech. Digitized speech, while remaining faithful to the original sound, requires 10K to 20K bytes per second of storage and is inflexible to phonetic manipulation.

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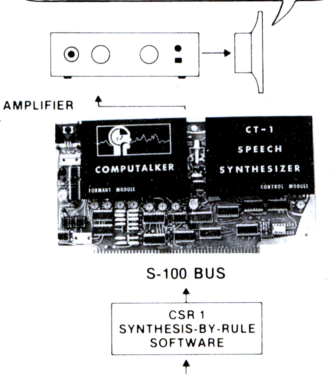
COMPUTALKER



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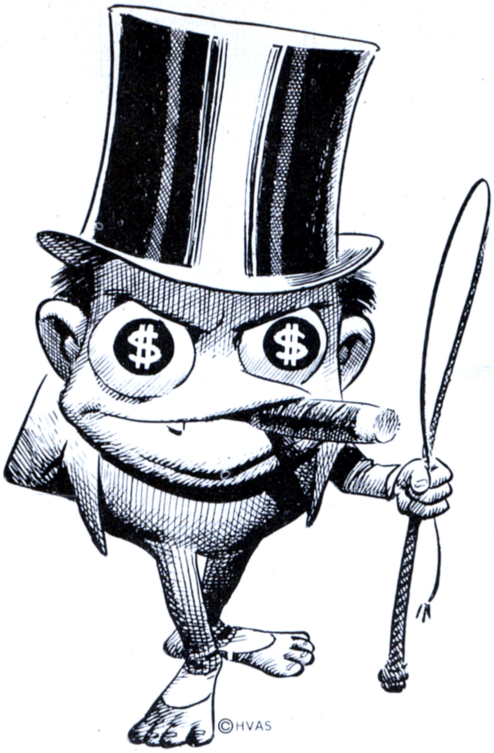
KEEPING THE LOAN ARRANGER HONEST



James A. Warden*

Most of us have borrowed money at some time, whether to buy a house, to pay for a car or a large appliance, or to extend payment on a revolving charge account. The truth-in-lending laws may have made us aware that loans do cost money and that we can shop around for a place to borrow, but the details of computing the monthly payment schedule may still seem a bit mysterious. Yet these calculations are in fact quite easy and anyone with access to a computer (or even a calculator) can crank out loan schedules at will.

Let's get a few basic facts straight first. Usually we borrow an amount of money known as the principal amount, which is to be paid back in monthly installments. We must pay interest on the loan each month, which is based on an annual percentage of the principal, or the annual interest rate. We might wish to know answers to these questions about the loan: If I want to pay it back in N months, what is the monthly payment? If I want to pay back so much per month, how long will it take to repay it? What is the total amount I will pay?

There are standard loan formulas which can provide the answers, and these formulas really are not difficult to use. but you can't generate a payment schedule with them, and you may not wish to bother with the mathematics necessary to derive them. Instead, we can consider a simple recursive procedure which will provide all the answers to allow us to see what is going on at the same time. If we borrow an amount P and pay it back monthly at an annual interest rate of R (per cent), our monthly payment M is used first to pay the interest which has accrued on the principal during the month. Expressed mathematically, the interest due on the principal remaining is $I = P*R/1200$. The 1200 comes in because we must divide the annual rate by 12 to get the monthly rate, and we must divide the percentage by 100 to obtain a fraction. The monthly payment reduces the principal by M-I, leaving P+I-M to be repaid. Expressing this in the form of a "recursive relation", we have that $P(new) = P+I-M$, which tells us how much we have left to pay (the new principal amount) after making a payment on the old P. To find out how much we will owe next month, we take P(new), insert it in place of P, and repeat the calculation. Eventually, P(new) will be reduced to nothing, and we can "burn the note". Of course, P(new) may turn up negative on a particular payment, meaning that the payment M will overpay the loan. In this case, the final payment will be whatever principal is left plus the interest owed on it, or P+I. This algorithm is illustrated in flowchart form below.

To find out how many months it will take to repay the loan, we simply have to choose a monthly payment, start with the principal amount owed, compute the new principal owed after a month, and repeat the operation until the principal drops to zero, printing the result each cycle. If we also put a counter in the loop and display payment numbers, the number of payments will be obvious. Finding a monthly payment which pays back the loan in exactly N payments requires a bit of guesswork. Here we pick a reasonable payment, run the calculation until the principal drops to zero, note the number of months required to pay, and then adjust our guess of the monthly payment to come out closer to the desired N on the next calculation. In either case, simply summing the monthly payments made will give the total cost of the loan. That's all there is to the technique! If it still sounds a bit vague, study the flowchart. This algorithm can be written up in BASIC, FORTRAN or a calculator procedure.

If you would like some practice or you wish to introduce this technique to someone else, the BASIC program LOANER may be of help. This program is one of a series of routines used at Wabash College to generate random exercises for the elementary computer science classes. LOANER will make up loan problems at random and use standard loan formulas to estimate values for number of payments for a given monthly payment and the total amount paid.

I would like to thank Prof. T. Mielke of the Wabash Mathematics Department for some of the ideas developed in this article.

---

* Cragwall Computer Center Wabash College Crawfordsville, Indiana 47933

PROSPERITY

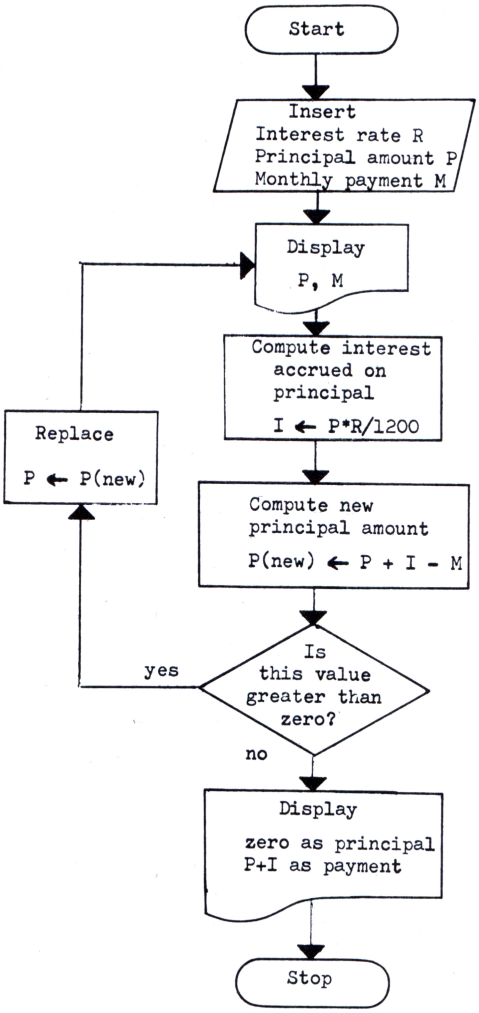

Start
Insert
Interest rate R
Principal amount P
Monthly payment M
Display
P, M
Compute interest
accrued on
principal
I ← P*R/1200
Compute new
principal amount
P(new) ← P + I - M
Is
this value
greater than
zero?
yes
no
Replace
P ← P(new)
Display
zero as principal
P+I as payment
Stop

Fig. 1 -- Flowchart for an algorithm which
generates an amortization schedule

```
100 REM LOANER -- AN EXERCISE GENERATOR
120 REM J. WARDEN        WABASH COLLEGE
140     RANDOMIZE
160 REM GENERATE VALUES OF PRINCIPAL, RATE, AND PAYMENT
180     P=INT(RND*500)*10+1000.
200     R=INT(RND*20+20)*.5
220     M=INT(P*(.07+RND*.05))
240 PRINT
260 PRINT"WRITE A BASIC PROGRAM WHICH WILL GENERATE AN AMORTIZATION"
280 PRINT"SCHEDULE OF MONTHLY PAYMENTS FOR A LOAN OF  $";P
300 PRINT"TO BE REPAID AT AN ANNUAL INTEREST RATE OF";R;"PER CENT."
320 PRINT"ASSUME THAT THE MONTHLY PAYMENT IS  $";M" ."
340 PRINT
360 PRINT"INCLUDE IN THE SCHEDULE THE PAYMENT NUMBER, THE PRINCIPAL"
380 PRINT"REMAINING, INTEREST, AMOUNT PAID TO PRINCIPAL, AND THE"
400 PRINT"PAYMENT.  AT THE END, DISPLAY THE TOTAL AMOUNT PAID."
420 REM GENERATE COMPARISON VALUES FOR NUMBER OF PAYMENTS
440 REM AND TOTAL AMOUNT PAID FOR THE LOAN
460     A = 1 + R/1200
480     N=INT( (LOG(M)-LOG(M-P*(A-1.)))/LOG(A) )
500     A2=(1.-A^N)/(1-A)
520     T=P+(R/1200)*(P*A2 - M*(N-A2)/(1-A))
540     T=INT(T+.49)
560 PRINT
580 PRINT"(HINT: FOR THE FIGURES GIVEN, THE LOAN SHOULD REQUIRE";N
600 PRINT"PAYMENTS AND A TOTAL OF ABOUT  $";T;"WILL BE PAID.)"
620 END

READY
```

This tale of another of the famous detective's triumphs was preceded in the May-June issue by a two-part introduction, which delved into Mycroft Holme's astonishing alter ego and Sherlock's curiously prophetic musings on how the analytical engine might be improved.

Sherlock Holmes and Charles Babbage

Ian Malcolm Earlson

III. The Scandal at the Cavendish Card Club

It was early in November of '90 that I found myself on Baker Street in the course of my rounds of visiting patients. The snow which had been falling rather heavily in the morning had ceased. Although the streets were covered with a heavy slush, the pavements were reasonably clear. Thus when I found myself only a few minutes' walk from our old rooms at 221B, I recalled how only a month previous a chance visit had involved me in the rather exciting adventure of the Red-Headed League, and decided to call upon my friend, Sherlock Holmes, once more. I found him seated on the floor, his feet tucked under his legs yoga fashion, and an array of wax vestas strewn about before him. He seemed to be in deep concentration so, having removed my great coat and hung it by the door, I sat down upon the settee and watched as he carefully moved the sticks from place to place. Finally he nodded his head in approval and turned to face me.

"Watson!" he cried. "As ever you seem to find the opportune time to drop by."

"There was a convenient break in my scheduled rounds," said I, "and as the snow had all but stopped, I walked down from Marylebone Road. But what is the meaning of all these sticks scattered over the carpet?"

"Ah," he replied reaching a long thin arm out to the coalscuttle from which he retrieved a cigar, "it is part of a pretty little mystery which has recently come my way. But there just is not enough data. We must wait for more." He bit off the end of the cigar with a sharp snap of his teeth.

"We?" I queried raising my eyebrows.

"Well, since you have no need to return to your home tonight you have only a few more patients to call upon, I though you might join me here in an hour or so for a cold supper and thereby meet the harbinger of this little puzzle." Holmes picked up one of the vestas and, striking it upon the hearth, lit his cigar. Billows of thick, blue smoke were soon rumbling around the room.

"My dear Holmes," I ejaculated. "It is true that my wife is on a brief holiday to visit her old companion, Mrs. Cecil Forrester, and that I have only two calls remaining. But how on earth?"

"Pshaw, Watson, it is obviousness itself. When I see the polish almost completely missing from your boots, some recent stains on the side of your bowler, and the absence of your usual fresh collar, I can only conclude that you are sans wife."

"It is true," I laughed sheepishly. "Without Mary to look after my appearance I am inclined to become a little slovenly. But how do you deduce that I have only a few patients yet on today's list?" I extended my arms outward from my sides and looked myself up and down to see if some tell-tale clue was noticeable.

"Watson, Watson. What a boon to my morale you are. You, my dear fellow, told me so with your own lips."

"I never!"

"Not directly, but certainly you told me. Was not your very first utterance after your arrival that you had 'walked down for Marylebone Road'? Now I know that you usually make your calls in a hansom, and you certainly would have done so on a snowy day such as this. If you had more than a few calls remaining, you undoubtedly would have retained the cab and left it standing at the kerb. Ergo, you have so few remaining patients that you dismissed your cabby, and have decided to walk to your other places of call."

"Indeed it is so. You seem to read me like a book," I laughed once more. "But what is this mystery involving the matches?"

"Oh, it certainly will intrigue anyone whose interest in gambling is so intense that he can consume half his wound pension in racing debts," Holmes said slyly glancing up at me with a mischievous twinkle in his eye. He rose and paced to the bow window overlooking the street. Standing with his back to the light he went on, "It comes from a game, a game of chance, that has become a popular one at the Cavendish card club over the last several months. It seems harmless enough, but there is reason to believe that there has been foul play as of late. My client has played the game rather regularly with the infamous Colonel Sebastial Moran. You don't know the name?" he read my upraised eyebrows. "Well, suppose that I tell you he is an agent of Professor James Moriarty. Ah, now you are impressed.

"Well, in any case, the game is played according to the following rules." Holmes scooped up the vestas from the floor and dropped them on the table at my side. He then divided them into two uneven piles.

"The players take turns in drawing sticks from the two piles. Each player in his turn may do one of the following. He may remove any number of sticks from the first pile and none from the second. Alternatively he may remove none from the first pile and any number from the second. His only other choice is to remove the same number of sticks, not zero, from both piles."

"And the object of the game?" I asked.

"Is to remove the last stick or sticks, thereby leaving your op-

"He may remove any number of sticks from the first pile and none from the second. Alternatively he may remove none from the first pile and any number from the second. His only other choice is to remove the same number of sticks, not zero, from both piles."

ponent a situation where he cannot remove any sticks at all."

"But that is very much like the ancient Oriental game of Nim."

"Much like it," Holmes went on, "but not the same. It appears to require a much more subtle solution."

"In any case," said I, "it seems quite a just game with little room for cheating."

"One would think so and, taken as it stands, I believe it is a fair game. Yet Colonel Moran consistently emerges the winner and, knowing his reputation, I am inclined to agree with my client that there is some foulness afoot."

"Could there be some chicanery in the manner in which the wagers are made?"

"I have no doubt that such is the case," said Holmes.

"The betting proceeds thus. One player chooses a number of sticks for the first pile. His opponent then chooses the number in the second pile. His opponent then chooses the number in the second pile. The first player then names the amount to be bet, whereupon the second player makes the first move.

"Now at least one significant thing has emerged already. Moran consistently wins when he, as the first player, has made a sizeable wager. Moreover, Moran only bets large amounts when one of the piles contains a large number of sticks, say 40 or so. But he does not always bet heavily if the number of sticks is large. The size of the bet evidently depends in some way upon the number of sticks chosen by the second player for the second pile.

"Yet there is little use in speculating." He scrambled the piles of matches. "It wants more data, and that is what I expect to receive this evening in a few hours hence. If you would care to drop round about half past seven, we could have a bite to eat and await the arrival of Sir John Hardy."

With that I ventured out to finish my calls. The visits took somewhat longer than I had anticipated, and it was past eight before I returned to Baker Street. The snow had started to fall heavily again and was starting to drift. As I hurried along my way through the falling snow, an elegant brougham pulled up at the door of 221B as I was about one hundred yards yet away. A distinguished appearing gentleman alighted and ascended the stairs to Sherlock Holmes' rooms. I followed him almost immediately and noted the rather surprised look on his face as I came into the room practically on his heels.

"Ah, Watson. Let me introduce you to Sir John Hardy who has come to tell us a little more of the puzzling match game we discussed earlier today. Sir John, this is my colleague Dr. Watson who has on more than one occasion been of considerable assistance to me."

"Of course, I should have known," said the visitor with a polite but perfunctory bow in my direction. "I have heard of Dr. Watson through Major Prendergast of the Tankerville club. And even had I not, I would certainly be aware of his close ties with you, Mr. Holmes, from his brilliant accounts of your adventures."

"You are too kind sir," said I as I felt the blood rush to my face at the compliment.

"Indeed," said Holmes betraying just a little annoyance at Sir John's placement of the word "brilliant." "My time is limited. There are one or two other trivial matters in hand at the present and each commands a portion of my energies, so we had best get down to work."

"Of course," said the baronet as he removed his astrakhan overcoat and handed it to Holmes who hung it near the door.

"Before telling us of any new developments," said my companion, "perhaps you would be kind enough to recount your story from its beginnings for Watson's sake. I think that I too might profit from hearing the details once again."

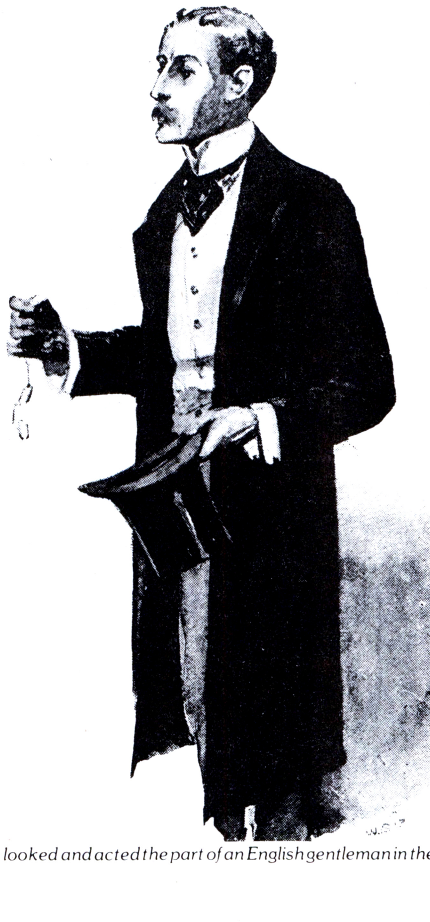
"With pleasure," said our visitor as Holmes ushered him into an arm chair. Sir John Hardy had an extremely courtly yet cheerful demeanour about him. He was exceedingly thin, with an aristocratic face and a mouth which seemed pulled up at the edges in a perpetual half-smile. A full head of flaxen hair was starting to show just a few touches of grey around both the temples and on his ample side whiskers. He wore a black frock coat, white waistcoat, patent leather shoes and neat light-coloured gaiters. All in all, he looked and acted the part of an English gentleman in the truest sense of the word.

"It all began," he commenced his narrative, "late last July shortly after the test match at Lord's. You may recall that the Bagatelle card club is just round the corner at St. John's Wood. Several of us had stopped for some light refreshments after the match, and there sitting at a table with a dozen or so cricket bails in front of him was Colonel Sebastian Moran. I had never met the man before but was introduced by a mutual friend, the right honourable Ronald Adair.

"Adair inquired after the bails and their purpose, and Moran explained that they were the main pieces in a new gambling game he had come upon recently. After some prodding we persuaded him to explain the rules to us."

"I think you may omit the rules of the game," Holmes interrupted. "Watson and I have discussed them earlier today. You recall them do you not?" I nodded in assent, and Sir John resumed his story.

"We three played the game in pairs for some time with very small stakes—a guinea or two on each game. I believe Adair was a slight winner, but there was not much in it."



All in all, he looked and acted the part of an English gentleman in the truest sense of the word.

"Well, that was the last of it until about a month ago when during a game of whist at the Cavendish card club, Colonel Moran recalled the game at St. John's Wood last summer. He made particular mention of the fact that he was certain the game was far from simple. I said, most casually I thought, that I certainly could not see any strategy for playing the game. At this point our two partners at whist, Mr. Godfrey Milner and Lord Balmoral, became intrigued by our discussion and asked about the game. Thus when we had finished our rubber, Moran pulled out several boxes of wooden matches, spread them on the table and described the rules."

"How many matches?" asked Holmes.

"I really couldn't say."

"Then how many boxes of matches?"

"I can't recall that either."

"What a pity. But pray continue," murmured Holmes as he leaned back in his chair in that familiar attitude, his eyes closed and his fingertips pressed together.

"The game went on into the early hours of the morning and at times the stakes became quite high. Moran was not a consistent winner, but in the end there was no question that he emerged some fifty pounds the better."

"Holmes nodded. "And then?"

"And then, we found ourselves in a game of sticks following our rubber of whist on every Saturday night. Colonel Moran continued to win although to all appearances the game is a fair and honest one. Then just Saturday before last— "

"That would be the first of the month."

"Precisely," said Sir John. "Lord Balmoral and I were having a quiet chat over a drink after the now regular sticks game. I expressed some concern over the fact that Moran always rose from the table richer than he was when he first sat down. I also noted that he seemed to win no more frequently than any one of the other of us, yet we were agreed he had a substantial profit overall."

"Lord Balmoral then remarked, 'Ah, but the Colonel wins when the stakes are high or, to be precise, when he himself has set a high stake.' "

Holmes chuckled and rubbed his hands with glee. "You see, Watson, the case grows in interest."

"I suddenly realized that this raised the possibility of foul play and said as much to Lord Balmoral. The two of us tried to recall some of the details of the occasions when Moran had set and won large stakes. In all cases where Colonel Moran set a large stake he, of course, also must have chosen the first number and been the second player to remove sticks according to the rules. We recalled that Moran won when he chose 41 and Lord Balmoral chose 25. Later Moran again chose 41, but Lord Balmoral chose 43, so Moran made a modest wager and, as it happened, lost. The other cases where Moran won large amounts always occurred when he chose a number larger than 40, and when he elected to make a high wager. The cases we remembered were: Moran 44 and his opponent 27; and Moran 47 and his opponent 29."

"On the other hand, for the following cases Moran wagered quite a small amount: Moran 45 and his opponent 30; and Moran 45 and his opponent 49. In the latter case, he actually won."

Holmes rose and walked resolutely to the mantle, his chin sunk upon his breast, and his hands thrust into his trouser pockets. Sir John Hardy turned to face me and continued, "The upshot of it all was that at about five in the morning, Lord Balmoral and I agreed that I should attempt to enlist the aid of Mr. Holmes to untanlge this mystery. We were sure that Moran was using some method of which we knew nothing and were determined to stop him from taking advantage of us. I came round last Tuesday and laid our case before Mr. Holmes and he kindly consented to try to help us on the condition that I provide him with more results of the game. Tonight I am here with the results of Saturday last."

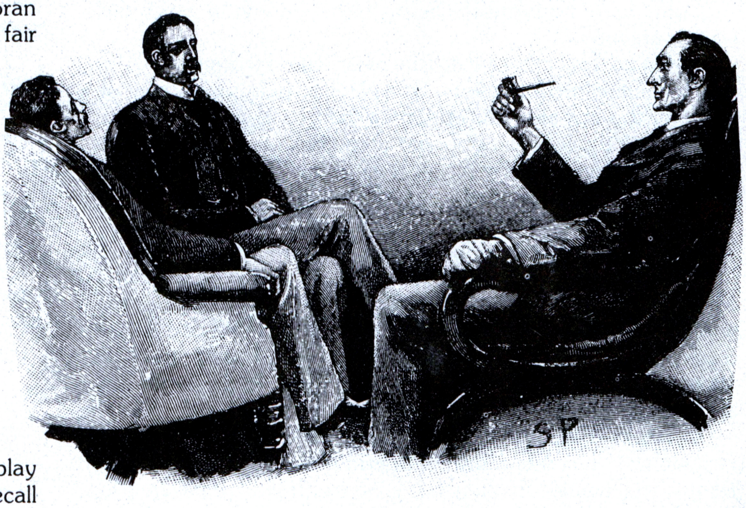
"The analytical engine can store one thousand numbers each with fifty digits."

With that Holmes broke his reverie and returned to where the baronet and I were seated. Our visitor removed a slip of paper from his pocketbook and unfolded it carefully. He placed it on the table between the arm chairs. Holmes stared at it for some minutes in silence. This is what it said:

8 November 1890

Moran	Opponent	Moran's Wager	Winner
49	30	100	Moran
49	52	10	Hardy
45	30	10	Moran
45	52	10	Moran
45	73	100	Moran

"The last one complicates matters considerably," said my friend with a furrowed brow and a deep frown upon his face. "You see, Watson, it doesn't pay to construct theories without sufficient data. Now I must clear my brain of its preconceived notions and start afresh," he concluded as he threw himself down into the chair opposite.



"You think then that we have been cheated?" queried Sir John.

"On the chance that it might be of some use to you, I have also recorded the entire play of some of the more brief games," said the baronet.

Holmes sat bolt upright in his chair. "Indeed," he said with unconcealed excitement, "you are an ideal client, Sir John. It is a pleasure to do business with you. I pray you, let us see them."

His client, obviously delighted at this compliment from the celebrated detective, took from his pocketbook several other sheets of paper. The first read thus:

	Pile 1	Pile 2
Start	8	15
Milner removes 3 from pile 2	8	12
Moran removes 2 from each pile	6	10
Milner removes 3 from pile 1	3	10
Moran removes 5 from pile 2	3	5
Milner removes 1 from pile 1	2	5
Moran removes 4 from pile 2	2	1
Milner removes 1 from pile 2	2	0
Moran removes 2 from pile 1	0	0

MORAN WINS

The second read:

	Pile 1	Pile 2
Start	20	12
Balmoral removes 14 from pile 1	6	12
Moran removes 2 from pile 2	6	10
Balmoral removes 3 from pile 2	6	7
Moran removes 5 from each pile	1	2
Balmoral removes 1 from pile 2	1	1
Moran removes 1 from both piles	0	0

MORAN WINS

"I have no doubt that the solution is to be found in these records," said Holmes after some minutes of study.

"You think then that we have been cheated?" queried Sir John.

"I have no doubt that it is not a fair game in the sense that at times Colonel Moran *knows* that he will win. Since you and his other opponents obviously are not aware of this fact, then to that extent there has been cheating involved."

Sir John Hardy became very somber. "This would be a serious charge indeed if it can be proved, Mr. Holmes. It would mean expulsion of Colonel Moran from the Cavendish card club. One of the specific, and strictly enforced, rules of the club is that if any member should become aware of a strategy for any game, he must notify the secretary of the fact, and the secretary must duly post the information."

"Perhaps Colonel Moran has informed the secretary," I interjected.

"It is impossible," the baronet responded.

"Why?"

"Because *I* am the secretary."

Some time later after the distinguished client had departed, and Holmes and I had finished our delayed supper, my friend leaned back in his arm chair and lit his pipe.

"You see the difficulty, of course, Watson."

"I see nothing at all," said I.

"Obviously there are certain opening combinations of numbers which are sure winners for the second player. It is those upon which Moran wagers large sums." Here Holmes withdrew from his pocket the slips of paper on which the results of the games were recorded.

"You will note that Moran bet large amounts when the opening combination was 41, 25. he did likewise on 44, 27 and 47, 29 and 49, 30. These then must be combinations which guarantee the second player is the ultimate winner. Now you will recall that Sir John himself had noticed that one of the numbers always was larger than 40, and from this data I assumed that the second number must always be less than 40. But these most recent results produced a certain winner from 45, 73. It was that pair of numbers to which I referred when I openly chastised myself for constructing theories with insufficient evidence."

"But," I volunteered after studying the results, "Moran also won when the starting pairs were 45, 49, and 45, 30 and 42, 52."

"Ah, but you will note that these were with small wagers. Ten pounds I believe. It is my contention therefore that these were fair games, and Moran won by chance. You will recall that he also lost with one of those combinations, namely 45,30."

"I don't see that there are any clues at all in that case."

"On the contrary, Watson. There are several. We know that there *are* winning combinations for the second player. If Moran can find them, so can we. I think it is safe to assume that there are winning combinations where neither number is greater than 40. Why then does Moran confine his large wagers to the cases where one number exceeds 40? Presumably because for smaller numbers it is likely that one of his opponents will see through the strategy and either defeat him or expose him. We should take this cue from him and look for small winning combinations in the hope of unraveling the mystery.

"Finally, Watson, I shall be very much mistaken if the solution does not lie in the complete records of the two games which our client has so thoughtfully provided for us."

"Obviously there are certain opening combinations of numbers which are sure winners for the second player. It is those upon which Moran wagers large sums."

"I am afraid it is all beyond me," I sighed. "What do you plan to do now?"

"I plan to get myself several ounces of excellent shag and curl up on the settee with a pipe," said my companion. "By the way," he added looking out of our window," the snow is drifting badly now. Your old room is still vacant. I have no doubt that Mrs. Hudson could make it habitable in short order if you care to spend the night rather than brave the storm."

My days in Afghanistan had prepared me to be comfortable with the barest of essentials, and I was anxious to see the outcome of this little mystery, so I accepted the invitation. The next morning when I came down to breakfast, I found the room filled with blue clouds of smoke and the carpet round the settee littered with not only the ashes from several ounces of pipe tobacco but with several dozens of cigarette ends. Holmes was leaning back in his arm chair robed in his mouse-colored dressing gown, but his face won an expression of excitement that told me that his night had been a fruitful one.

"You slept well?" he greeted me.

"Extremely. But I see that you did not sleep at all."

"No, but I venture to say my mind is more rested than yours. the brain is a muscle, *the* muscle one might almost say; exercise serves to refresh it, and I have exercised my brain considerably over the past several hours."

"You have solved the problem then?"

"I have in principle."

"In principle?"

"Well," said Holmes as he rose and stretched his long limbs, "I know how to solve the problem, but I have need of brother Mycroft or, to be more precise, I have need of the Babbage difference engine in order to reach the solution."

"I confess I am in the dark as much as ever," I responded.

Holmes chuckled, "If you care to drop round about six tonight, you can join me in a stroll to the Diogenes club where we will discuss the matter with Mycroft. In the meantime you might contemplate that it is the difference engine which holds the key."

So it was that at approximately half six Sherlock Holmes and I found ourselves seated in overstuffed chairs with luxurious leather coverings in the Strangers' Room of the Diogenes club in Pall Mall. Seated opposite us was the corpulent figure of Mycroft Holmes. The eyes, set deep in his massive face, maintained a far-away, watery gaze as his brother recounted the story of the game of sticks. His only reaction to the narrative was an occasional slight upward flick of the corners of his mouth.

"Of course, there is an array of winning pairs," Mycroft said, "each with the property that it is impossible to move from one winning pair to another in one move. On the other hand, it must always be possible to get to a new winning pair in two moves regardless of what the first of those two moves is."

"Precisely," said Holmes. "Now consider the pair 1, 2. It obviously is a winning one for the second player. What choices has the first player? He can remove sticks from the second pile or from the first pile, or he can remove equal numbers from both piles. We will consider them in that order."

"If the first player removes sticks only from the second pile, he has the choice of removing one or two. If he removes one leaving 1, 1 the second player then will remove one from each pile to produce 0, 0 and win. If the first player removes two from the second pile leaving 1, 0 then the second player takes one from the first pile. Therefore, the first player cannot win by simply removing sticks from the second pile.

“If the first player elects to remove sticks from the first pile, he must remove one leaving 0, 2 and the second player will remove two from the second pile and win.

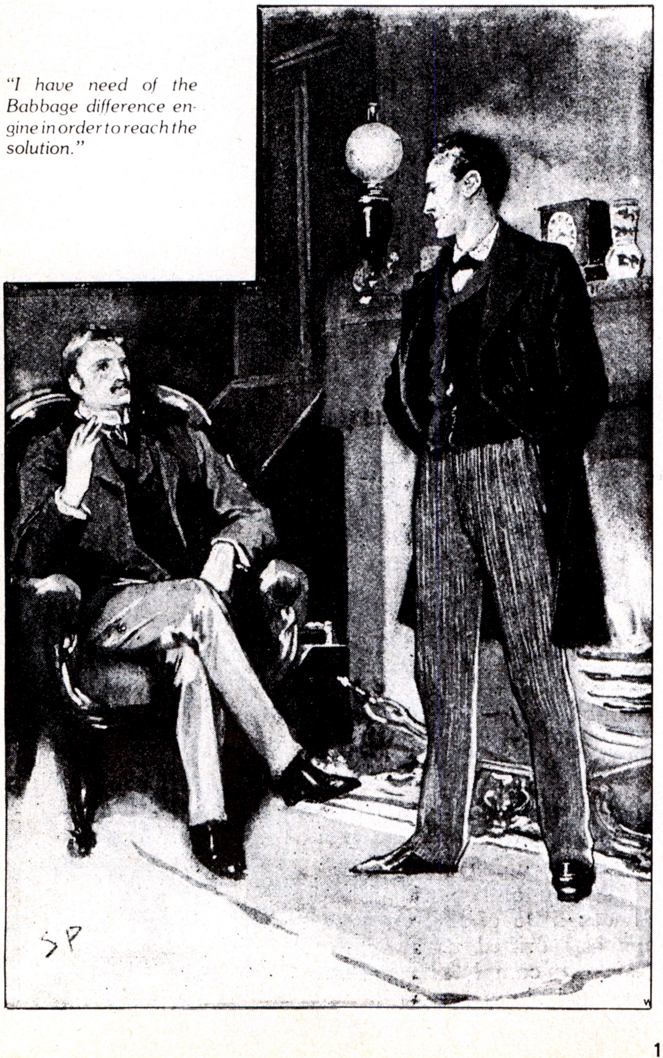
“The only other choice available to the first player is to remove the same number of sticks from both piles. In this case, since the first pile has only one stick, the only possible choice is to remove one stick from both piles. This would leave 0, 1 and the second player again wins by removing one stick from the second pile.”

“Quite so,” said Mycroft for the first time exhibiting any emotion. “So that 1, 2 or of course 2, 1 is a winning position for the second player.”

“Sherlock Holmes smiled in obvious delight at exhibiting the solution to his elder brother. “The next winning pair is 3,5. If the first player removes sticks from the first pile, then the first pile will have 0,1 or 2 sticks. The second player then reduces the second pile so that the result is 0, 0 or 1, 2 or 2, 1 and thereby puts himself in a winning position once more.

“If the first player chooses to remove sticks from the second pile, the situation is slightly more complicated. First suppose he removes three or more sticks. This again leaves 0, 1 or 2 sticks in the second pile, so the second player reduces the first pile so that the result is 0, 0 or 2, 1 or 1, 2. If the first player removes two from the second pile, the result is 3, 3. In this case the second player removes 3 from both piles to win. The only other choice available to the first player is to remove one stick form the second pile producing 3, 4.”

“In that case,” interjected Mycroft, “the second player need only remove two sticks from both piles to produce 1, 2 and again he will win.”



“I have need of the Babbage difference engine in order to reach the solution.”

“But suppose the first player elects to remove sticks from both piles?” I asked.

“I was just coming to that,” said Sherlock Holmes. “In removing sticks from both piles, the same number must be removed from each pile. Thus the possible outcomes are 2, 4 or 1, 3 or 0, 2. In the first case; 2, 4; the second player takes three from the second pile. In the second case; 1, 3; he takes one from the second pile. In either of these cases the second player leaves either 2, 1 or 1, 2 both of which lead to a win for him. The last case; 0, 2; is clearly a win for the second player since he simply removes both sticks from the second pile.”

“Yes, yes,” said Mycroft with some impatience. “So the winning pairs for the second player are 0, 0 and 1, 2 and 3, 5.”

“The key,” responded his brother, “is to note the differences between the two numbers in each winning pair. The difference between 0 and 0 is 0. The difference between 1 and 2 is 1. The difference between 3 and 5 is 2.”

“Ah,” murmured Mycroft, “the differences increase by one each time so the next difference is three and next winning pair is 4, 7”.

“And the next is 5, 9,” I ejaculated finally, I thought, grasping the pattern.

Both brothers turned to stare at me with looks of incredulity on their faces.

“ ’Pon my word Watson, I should enjoy playing against you,” said Sherlock Holmes.

“Eh?” I half mumbled realizing that I must have made some stupid blunder.

“If you, as second player, left me with 5, 9 then I should simply remove 6 from the second pile producing 5, 3 which would place me in the winning position.”

“No, no, no” said Mycroft his gaze wandering to the window. “It is clear that we must skip over five. The next winning pair is 6, 10.”

“Yes,” said Sherlock, “the winning pairs for the second player are

0, 0
1, 2
3, 5
4, 7
6, 10

then

8, 13

since 7 must also be skipped because it appeared earlier coupled with 4.

“The pattern then continues. Each difference increases by one so that the next difference is six and the winning pair is 9, 15. Of course, one must always check that the first number did not appear earlier as a second number.”

With a broad smile Mycroft Homes leaned back in his chair, “So you need the Babbage engine,” he said.

“It does seem an ideal task for you and the difference engine,” said Holmes. “I must have the winning pairs at least into the 40’s since obviously Colonel Moran does. Of course, I was able to prepare such a table for myself using nothing more than paper and pen. But,” he added, “if I could go further, say into the 80’s or 100’s, then I believe that I could beat Moran at his own game. A table extending that far is, I am afraid, beyond my meagre bookkeeping abilities.”

“Unfortunately,” responded Mycroft, “the difference engine cannot provide you with those numbers. You see, that machine has no store so it would not be possible to maintain a record of the early winning combinations. Without such a record one could not skip over the numbers which had appeared in the previous winning pairs.”

Sherlock Holmes’ entire body sagged so that he took on the appearance of a straw man. Despair lined his face. He leaned forward with his elbows upon his knees and his chin between his palms and remained motionless in that position for some minutes. All the while his brother sat equally still but with just a hint of a smile flickering on his lips and an uncharacteristic twinkle in his eye.

The silence was finally broken when Mycroft said, in the most casual and offhand way, "It is fortuitous indeed, Sherlock that just last week Major General Babbage and I completed the new analytical engine for, in contrast to the difference engine, it does have an ample store. In fact the analytical engine can store one thousand numbers each with fifty digits."

Sherlock Holmes looked like a man stunned by a blow to the solar plexus. His expression changed so rapidly from despair-to-shock-to-joy that he appeared to be part of a kaleidoscope. When he first opened his mouth, no words came forth. Finally he cried, "Mycroft! Do you mean to say that you do in fact have a machine which will compute the winning pairs?"

"Yes," chuckled his brother, "the analytical engine can easily produce what you wish. In fact your little puzzle will be an excellent means for testing the new machine's mettle. Of course, it will take some cleverness on my part in preparing the directive cards," he continued, "primarily because of the requirement to skip over certain numbers. But I think that by tomorrow at this time I can give you a table up into the hundreds if you so desire Sherlock."

"Excellent," replied my friend rubbing his hands with some glee. "We will have our revenge upon Professor Moriarty unless I miss my guess."

"Moriarty?" I exclaimed.

"Yes, Watson, Moriarty. There can be no doubt that it is his great mathematical brain which lies behind this vile deceit. Moran is only his agent, his tool. Moriarty undoubtedly feeds Moran the winning pairs, and Moran who incidentally has a remarkable memory, uses that information to cheat his colleagues at the card club. Moran, I would guess, does not know how to calculate the winning pairs himself. And that, of course, is our salvation. If we can catch him with some pairs which he does not know, then we can beat him as he has beaten others."

As we strolled back down Pall Mall towards the St. James's end, Holmes seemed deep in thought. I knew that on such occasions he disliked any disruption in his mental patterns so I maintained a discreet silence. Suddenly his coutenance brightened.

"Yes, that is it," he cried.

"What?"

"Oh, simply the plan to use the information which Mycroft will provide to us. But there is little to be gained until tomorrow. If you are not busy with your practice perhaps you would like to join me tomorrow afternoon at St. James's Hall. Paderewski is giving his first recital of the season at 3 pm.'

"Really, Watson," said Sherlock Holmes with a hearty laugh, "I do believe you were planning to take advantage of me." I turned to see my friend standing in the attire of Sir John hardy but with a flaxen-haired wig in his hand and a large grin on his face.

"You see," he went on, "I wanted to give my disguise the most stern test I could muster. If I could fool you, Watson, I must be able to fool anyone."

"What is this all about, Mr. Holmes?" said Sir John as he walked uncertainly to the center of the room.

"Yes, confound it Holmes. What is all this about?" I added having at least somewhat regained my composure.

"Sit down, both of you, and I shall tell you," said my friend. As the three of us sat in a circle, Holmes explained that he planned to substitute himself for Sir John Hardy that night at the whist game at the Cavendish club. When the after-whist sticks game commenced he would choose numbers in the 80's or 90's and, when a winning pair occurred, would bet exceptionally high and beat the Colonel at his own game.

"It is true that there are limits on the stakes?" he asked.

"None at all," replied the baronet. "But what are these 'winning pairs' of which you speak?"

Holmes once again broke into laughter. "It is the second time this evening that Watson has been asked that question. I dare say he will answer it this time. But I must be on my way, if my plan is to succeed. I will leave you two to study the game."

With that he disappeared into his bedroom and soon reappeared once more the perfect double of Sir John himself.

"I would swear I was looking into a mirror," said the baronet, "if I did not know better." Holmes removed our guest's overcoat from the place where it was hanging near the door.

"I trust you have no objection to my borrowing this. You will have no need of it since you must remain here in my rooms. Nor I presume do you object to my using your brougham for the evening. You did leave it standing at the kerb as I requested?" said Sherlock Holmes.

"It is waiting there, and I have no objection to your using any of my possessions if it will help in bringing to heel that scoundrel Moran," said Sir John.

"You have my guarantee that it will," responded Holmes. "Now Watson," he added, "lock the door behind me and admit no one. Moreover, do not under any circumstances allow Sir John to be seen from the window. The success of the entire plan depends upon the real Sir John Hardy not being seen by any other living soul. I leave him in your capable hands, Watson."

With that Sherlock Holmes vanished through the door and down the stairs. In a few moments we heard the sound of Sir John Hardy's brougham as it drove off carrying Holmes to his rendezvous with Colonel Moran at the Cavendish card club. I drew the blind at the window, and Sir John and I settled down in our armchairs for what turned out to be a long wait.

I expved the stragegy which Holmes had devised for the sticks game and enumerated some of the smaller winning pairs for the baronet. Sir John quickly realized that Moran must have known the winning pairs up through the 40's and had used that knowledge to gain unfair advantage.

My friend's client and I amused ourselves by playing a few games using large numbers of sticks for which neither of us could readily calculate winning pairs. More than once he wondered aloud at what actions Holmes might take that night. Would he trick Moran into betraying his villainy? Would he suddenly throw off his disguise to confront Moran? What would the other members of the club think of all this? Was this the gentlemanly way to resolve the problem?

I assured him that I had no more idea of what was to happen than did he himself, but that I was sure that Holmes would do nothing to disgrace Sir John or any members of the card club other than Colonel Moran. However, I must admit that as midnight came and went my patience too began to wear thin. It was shortly after one o'clock and I though I could bear no more of the baronet's questioning when we heard Holmes' latchkey in the door. Both Sir John and I leapt to our feet and rushed to the door. Holmes opened it and strode into the room. He appeared weary, and though his face was drawn it was creased with a broad smile.

"I think, Sir John, that the Cavendish card club has seen the last of Colonel Sebastian Moran," he said. Then he drew a wad of notes from his pocket and dropped it on the table. "You may count them," he continued dropping himself into an arm chair. "Unless I have made some error you should find more than 800 pounds and Colonel Moran's cheque for another 700. I trust you can arrange to repay all of those who lost at the sticks game through Moran's unfair tactics."

"Good heavens, Holmes," I ejaculated. "Tell us what happened."

"Oh, it was all very simple and straightforward. My impersonation of you, Sir John, worked to perfection. No one suspected all through the rubber although Lord Balmoral remarked once or twice that my play did not seem to be quite up to its usual standard," Holmes laughed.

"But then we came to the sticks game. I watched and waited for my opportunity. After having lost several times, I chose 81 when it came my turn to choose first. There were some good-natured jibes about wanting to prolong the game in order to delay losing my money.

So it was that on the afternoon of the twelfth Sherlock Holmes and I sat in the stalls and listened to the great Polish musician play Beethoven's *Sonata Opus III in C minor*. My friend sat enraptured by the music gazing out through half-closed eyelids and gently waving his elongated fingers in time with the music. I marveled once more at his uncanny ability to totally detach himself from his client's problems at his own command.

There had been a thick fog all day and snow had started to fall again during the concert. Nevertheless we made our way by foot to the Diogenes club where Mycroft Holmes proudly presented his brother with a long table of winning pairs for the second player in the sticks game. In part the table read

40	65
42	68
43	70
45	73
46	75
48	78
50	81

As we left, Sherlock Holmes suggested that I stop at our old rooms in Baker Street at about 6 pm on Saturday when he expected to bring our little gambling problem to its conclusion. Despite my questions he refused to divulge any further details of his plan. More than once during the ensuing days I found my mind wandering back to sticks, Colonel Sebastian Moran and Sir John Hardy.

November 15 brought heavy snow showers once more. By five o'clock the streets had been ploughed into a grey crumbly band by the traffic and the footpaths were slick and slippery. Thus it was that shortly before six I decided it best to hail a hansom. The cab rattled along rather slowly through the slushy streets to Holmes' lodgings. When I ascended the stairs and entered our old sitting room, I was startled to see not my old friend and colleague but his client, Sir John Hardy, seated in the armchair playing with two piles of vestas.

"I beg your pardon," I muttered half backing out of the door. "I had expected my friend Sherlock Holmes—"

"It is quite all right," said Sir John, the corners of his lips turning upward into the half-smile which had been his trademark among the betting gentry. "I too am expecting your friend. He was not expecting me until shortly after six, but when I arrived somewhat early his landlady, Mrs.— ah, Mrs.—"

"Hudson," I answered his unasked question.

"Yes, Mrs. Hudson, suggested that I wait for him here in his sitting room. I found some matches aready distributed in two piles, so I have amused myself by playing the sticks game against myself. Perhaps you would be so kind as to play the other side."

"Oh, quite," I responded, "although you should know that I have as yet not played the game with anyone.'

"I had no intenion of making a wager with you, Dr. Watson. Just a friendly game, you see."

"Well now, I have no objection to a small wager just to keep our interest up.'

"If you do not think you will be at a disadvantage," said the baronet.

"Not to worry. I think we will be on reasonably equal footing," I said feeling somewhat guilty that I knew at least some of the winning pairs. "Shall we say a crown?"

"A crown it is," replied Sir John dividing the matches into two piles, one of 14 and one of 23.

Unfortunately, responded Mycroft, "the difference engine cannot provide you with those numbers."

"Will you play first or last?" he asked. I did not know if 14, 23 was a winning pair for the second player, but I did know that there was only one winning number to match 14 and since he had chosen 23 at random, it was not likely to be such a winning pair. Thus I elected to play first. Recalling that 9, 15 was one of the winning pairs, I removed 5 matches from the first pile with the intention of reducing the second pile to 15 with my next move. However, Sir John Hardy promptly removed 8 from the second pile to produce 9, 15 himself. This must, of course, have beem mere chance, since he did not know the winning pairs. My next move then was to remove 3 from the second pile leaving 9, 12. My opponent, after some study, removed 5 from each pile to produce 4, 7—another winning combination. I now was becoming just a little suspicious. Had Sir John deceived Sherlock Holmes? Did he really know the secret of the game himself? Did he suspect that while Holmes might have solved the puzzle, I would have been kept in the dark? Out of the corner of my eye I carefully observed his movements. He tugged lightly at his side whiskers with his left hand. The thumb of his right hand was hooked under his white waist-coat at the shoulder. He seemed the picture of composure and assurance.

Boldly I decided to use the acid test. I removed two matches from the first box. With no hesitation Sir John removed six from the second to leave 2,1.

"Look here," I cried leaping to my feet, "this is unfair. You obviously know the winning pairs, and I have no doubt you intentionally started with a winning pair. It is hardly conduct worthy of a gentleman of your stature."

"I'm sure I don't know what you mean, Dr. Watson. What are these 'winning pairs' of which you speak? And did I not allow you the choice of playing first or second?"

Before I could reply there was a knock at the door. My opponent arouse to his feet, and I turned to see Mrs. Hudson usher into the room—none other than Sir John Hardy himself.

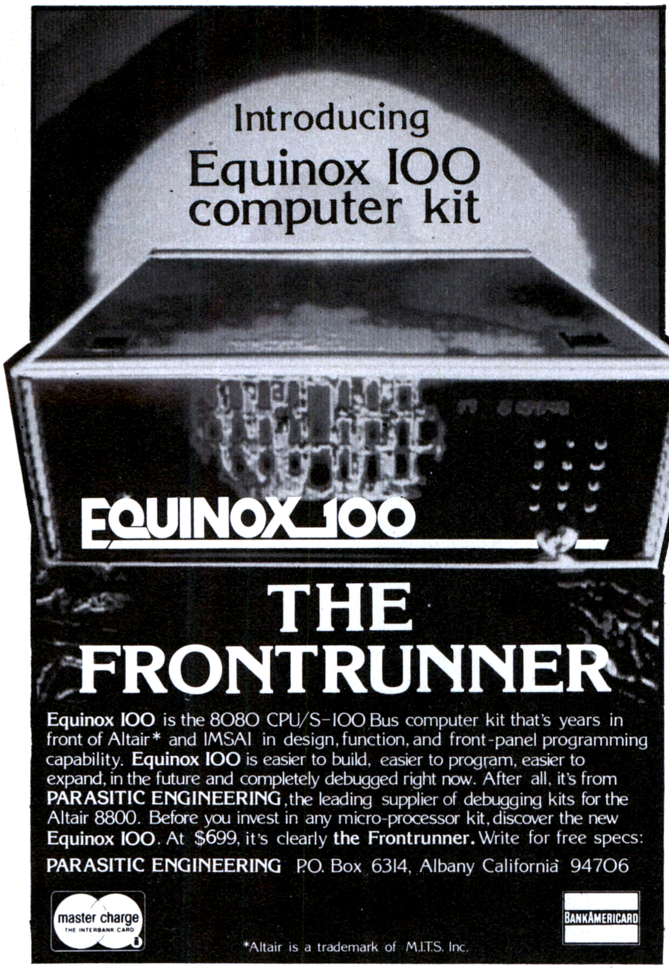
I stood in stunned silence for some minutes and was finally brought out of my state of shock by a familiar voice from behind me.

"Now I had noticed during the evening that when Moran was second and the first number was large, he chose a large number and usually a number ending in zero. I counted on him doing so again, and he did not fail me. He chose 50. It so happens that 50, 81 is a winning pair."

"How on earth did you know that?" asked the baronet.

With a wink in my direction Holmes told him that how he stumbled upon that particular pair made no difference. I winced at the poor pun. Holmes then went on to say that he wagered 1500 pounds and asked Moran to start the play.

"There were more than a few muffled words exchanged among your colleagues, then, Sir John. And Moran looked perplexed, but not particularly worried. It was clear to me that he did not realize the peril in which he lay. As the game pro-



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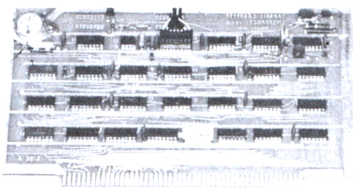

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gressed, however, Moran began to show more and more signs of nervousness. When he brashly lowered the larger pile to 52 and I countered by making the other pile 32, he knew his game was up.

"He eyed me with suspicion then and may have guessed my real identity or at least that I was an imposter. But, of course, he could not unmask me without at the same time betraying his own dishonesty. So the game proceeded. I suppose he hoped for some blunder on my part, but I had learned my lessons well. When we finally reached 6, 10 with Moran to play next, he conceded.

"There were cheers of delight, and I was hailed as a jolly good fellow and clapped on the shoulders until my entire back began to ache. Try as I might I could not leave until there had been drinks all around several times over. During all the merry-making, Moran had silently disappeared, but not before I had collected my ransom."

"I really can't find words to thank you, Mr. Holmes," said the baronet. "You have found the most painless and gentlemanly way out of this dilemna. You have righted all the wrongs including the effective expulsion of Colonel Moran from the club without the slightest hint of a scandal. How can I repay you?"

"My work," said Holmes, "is its own reward especially when I can gain the upper hand over Professor Moriarty."

"Professor Moriarty? But it was Colonel Moran whom you bested?" cried the baronet.

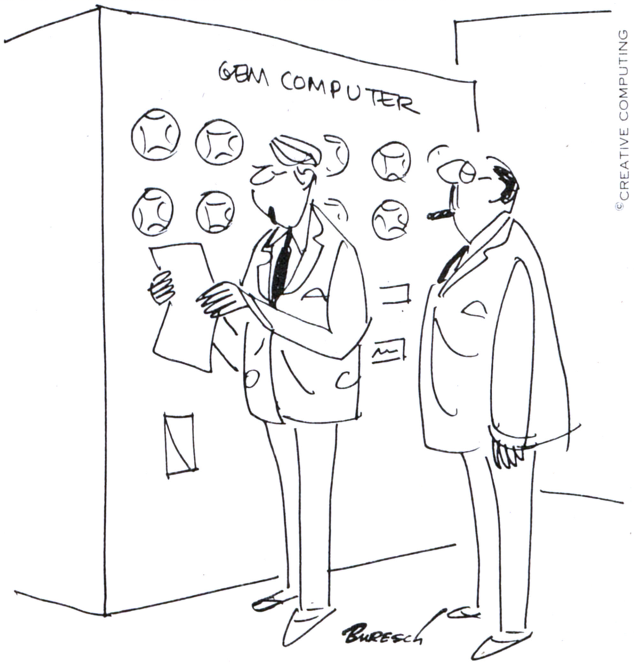
"Oh, yes, to be sure," Holmes replied with a wry smile.

"Nevertheless," insisted Sir John, "you have recovered a sum in excess of the comined losses of both me and my colleagues. The difference, I believe, is your just due."

With that the baronet handed over to my companion a sheaf of bank notes which looked to be at least several hundred pounds. Holmes accepted the offer without ceremony and rather cavalierly crammed the money into his pocket.

Then heaving a sigh of exhaustion he said to our guest, "Now if you will excuse me I will rid myself of this disguise so that Watson can discern which of us is the real Sir John Hardy. Then we can have a night-cap to celebrate our triumph."

As Holmes disappeared into his room he called over his shoulder, "You will find the gasogene and the brandy in their usual places, Watson. Will you do the honours?" ■



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"It gives the answer as 12,621,859.007. But, it says it's just a hunch."

ws... reviews... revi

Reviews Editor: John Lees
Box 789-M
Morristown, NJ 07960

Readers: Want to be a reviewer? Write to the Reviews Editor directly. Publishers: send material for review to the Reviews Editor.

Hi there, *Creative* readers! This is your new Reviews Editor, John Lees, speaking. As part of our ongoing disorganization, Peter Kugel has moved on to other things and I am taking over this section. Not being a person inclined to leave well enough alone, I am of course going to make some changes in the format of the Reviews.

Most noticeably I am going to begin the Reviews section with a column in which I will review a book or two and comment on this and that. The nucleus of the section will still be reviews done by our volunteer reviewers, as in the past. Since we receive far more books than we can possible review, I'm going to instigate a listing, with brief comments, of those books which I feel will be of interest to some of our readers, but which I don't think warrant full-fledged reviews. This way you'll at least find out that such books exist.

A few words about myself: I've been on the staff of *Creative Computing* as an Associate Editor for two years and have written a number of articles and reviews during that period. I am 25 years old and hold a B.A. in Philosophy and an M.S. in Computer Science. My hobbies include working for NCR/Data Processing Division in Wichita, drawing comics, trying to get some science fiction published, and going to National Computer Conferences.

Because of asynchronous timing foul-ups, I don't have much material for this particular column, so I'll comment on this and that instead.

The primary purpose of this section is to keep you informed about interesting and useful new books. A great many of the books reviewed here will never show up even in fairly large bookstores. Therefore our reviews are mostly informative in nature; telling you what a book has to offer and how to get hold of it if it sounds interesting to you. Although the reviewer is free to, and usually does, give an opinion on the worth of a book, the reviews are not "critical" reviews. *Creative Computing* is not, after all, a professional journal, the reviewer cannot assume that the reader has read the book being reviewed (in fact the reverse is assumed), the reviewer is a volunteer possibly writing his or her first book review for publication, and the books themselves range from the trivial and elementary to the erudite and esoteric.

Actually, we're just a large bunch of friends answering in a more formal than usual manner, the question, "Have you read any good books lately?" Hopefully we're providing each other with better information than is found on the obviously biased jackets of the books themselves.

If you should drastically disagree with a review of a book, or if you find mistakes in a book which you think other people would like to know about, or if you've heard of some book but can't find it and would like to see it reviewed, let me know about it, and I'll see what I can do. By the way, most authors like to have any real mistakes in their books pointed out to them so that they can be corrected in later editions. You can write to an author in care of the publisher.

As for finding copies of the books reviewed here, there are several possibilities if your favorite bookstore doesn't carry them. You can try your local computer or amateur radio store. If that fails, you can order many books from the *Creative Computing* book service, which is frequently faster than ordering through a bookstore, especially with paperbacks. Keep in mind also that most public library systems will acquire a book if enough people ask for it.

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* * *

Introduction to Computer Data Processing, 2nd edition, Wilson T. Price, Dryden Press. 500 pp. 1977.

In the words of the author, "The primary purpose of this book [is] to provide that basic understanding of the computer, what it cannot do for us, what it can do for us, and how it is programmed to serve our needs." He achieves this purpose through the use of examples. Every new concept is presented in the form of an example from everyday life, such as college class scheduling, inventory record-keeping, or utility-company billing procedures.

The simplicity and clarity of language used is to commended. As a former programming student, I can appreciate the difficulty of wading through a mountain of technical jargon as the beginner often does. As a matter of fact, actual definitions are kept to a minimum in this text.

The organization of the book is fairly straightforward. It begins with a simple introduction to computers in general and then data processing, first using manual methods and later machine methods. Next is given a short history of the punched card and the modern digital computer. Then I/0 devices and media and internal codes are covered. Midway through the book is an introduction to programming using a hypothetical computer, followed by three chapters on languages - one each for Basic, Fortran, and Cobol, giving actual programs which can be run on an available machine. The last few chapters concern computer hardware, software, and the implementation of a computer data processing system. There is an appendix on the use of the keypunch, a glossary, and a machine-language simulator. A smooth transition is made from each unit to the next and there is a great continuity throughout, although it would be feasible to jump around from chapter to chapter without much confusion.

Extra features of the book include exercises, which really aren't too difficult for your average college freshman, and comic strips, advertisements, and articles from various magazines, including a number of things from a certain publication out of Morristown, New Jersey.

This book would be excellent for courses which are meant to give a basic understanding of a computer system. The student who plans to continue in computer science, however, would probably find that the book doesn't go into enough detail. It would also be possible for an interested person to read through this book on their own to gain an overview of electronic data processing.

Julie Seidler
Overland, MO

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The Best of Creative Computing, Volume 1, edited by David H. Ahl, 317 pages, $8.95 Creative Computing Press, P.O. Box 789-M, Morristown, NJ 07960. 1976.

In the preface, the editor states the material in the book is *"diverse."* That comment is not an understatement. There is material and information for everyone interested in computers. Just as the material originated from a wide range of sources, so its appeal is also far-reaching. The table of contents indicates the breadth of material from articles and commentary to fiction and poetry, a little foolishness, puzzles and problems as well as a wide array of computer games and book reviews.

The book consists of the material first seen in Volume 1, issues 1 through 6, of *Creative Computing.* The material has been collected under the headings indicated above, but retains the exciting reading always present in each issue of *Creative Computing.*

The book contains something for people of all ages, from games for the young to puzzles and articles designed to keep one in deep thought for hours.

The book is recommended for all ages as a volume that can be picked up and read anywhere for any length of time. For those who have been late in subscribing to *Creative Computing,* this volume is now the only source of those back issues of Volume 1 that have been sold out.

John J. Jackobs
Coe College
Cedar Rapids, Iowa

BASIC Software Library, Volume II Engineering and Statistics. R.W. Brown, 260 pp. paper, $24.95. Scientific Research Instruments, PO Box 2096, Ashland VA 23005.

The BASIC Software Library Volume II is a compilation (if you'll excuse the term) of forty-four applications programs in the areas of engineering and statistics. An ad for this series of books in a hobby computer magazine tells us, "The intention of this work is to allow the average individual to easily perform useful and productive tasks with a computer... This library is destined to become one of the reference bibles for the small computer field...." The ad further states that ALL the programs are written in compatible BASIC executable in 4K MITS, SPHERE, IMS, SWTPC, PDP, etc. BASIC compilers. All right, so everyone gets a little carried away sometimes. But since many personal computer owners *are* looking for applications software, how good is this book?

The programs themselves range widely in degree of generality. Almost anyone can use a program which graphs two functions on a TTY. However it seems quite unlikely that the average personal computer user is going to need to calculate the thickness of a steel beam. The *BASIC Software Library* does not attempt to explain the applications it covers—nor should it—since you should already understand your application before you try to apply a computer to it. If you're into mathematics or statistics, or need to plot functions or data, this book may be for you. If you have a very specific application you'd probably better have a look at the table of contents before you buy.

As far as the programming techniques used, most of the programs seem reasonably efficient and we especially liked one that produced random numbers without RND, in just 12 short lines of BASIC. One program which caculates positions of stars was annoyingly inefficient using the following technique for printing the name of star #W.

```
IF W=1 THEN AAAA
IF W=2 THEN BBBB
IF W=3 THEN CCCC etc.
  and then to print the names:
AAAA PRINT "name 1"
     GOTO XXXX
BBBB PRINT "name2"
     GOTO XXXX
CCCC PRINT "name3"
     GOTO XXXX
```

and so on, which could be done more efficiently with DATA statements and a read loop. Additionally the programs are not nearly as transportable as stated, since they sometimes use user-defined functions, exponentiation, character strings, and mass-storage files. There's nothing wrong with that, but you shouldn't say that *all* your programs run in 4K BASIC on a micro if they don't.

$24.95 is a lot of money to pay for a softcover book, especially when some of the pages are almost too light to read, and in other places corrections to the original program run have been written in by hand. If you need to compute integrals or linear regressions or even thicknesses of steel beams, then the *Software Library* could save you a lot of time spent in research, program writing, and debugging. But before you buy it, you should seriously consider whether or not the book will help you with your application.

Steve North
Newfoundland, NJ

CMOS Cookbook, by Don Lancaster. Howard W. Sams & Co., Inc., Indianapolis, IN 46268. 414 pp., paperback, $9.95. 1977.

If your logic projects have been thwarted because you didn't have the regulated power supply that was required, or you were afraid that you'd goof up the assembly and blow up the whole circuit, or if you're fed up with all the hassles of TTL, then CMOS is for you, and Don Lancaster's *CMOS Cookbook* is for you.

CMOS is a very easy logic family to use. It can even be fun for once to build all those logic projects. You don't need to worry about the power supply; CMOS tolerates unregulated, noisy power supplies and helps out by using very little current. Even with all its nice features, CMOS is very low in cost.

This book covers the typical applications for a logic family and some features which make CMOS particularly useful in certain applications. The uses for CMOS that have no counterparts in any other logic family are detailed, as are its few disadvantages.

The first chapter supplies all the background information on CMOS — how and why it works, some unique features, usage rules, power-supply design, and general practices to be followed in design. Chapter Two is a hundred pages of individual descriptions of CMOS devices. Each description gives you only the information you need to know to use the device, and the problems and restrictions in using any device are clearly laid out so that you won't have any surprises later on.

Chapter Three covers logic design starting with the basics and moving up to the use of transmission gates and tri-state buffers. The latest techniques of redundant logic design using data selectors, ROMs, PLAs, and microprocessors are presented as approaches to simplifying complex problems that previously could have required high cost and much time spent on design and modification. It is in this chapter that Mickey Mouse logic is introduced as a trick for simplifying some designs.

Chapter Four describes CMOS multivibrators. Five develops clocked logic from fundamentals and describes the available CMOS flipflops and their applications. Six carries the applications to larger-scale sequential design using shift registers and counters, detailing use of these in computer and music applications. The use of CMOS in some unique ways is the subject of Chapter Seven, where you learn of CMOS used in operational amplifiers, bidirectional analog switches and phase lock loops.

The last chapter is devoted to full-scale applications of CMOS. These include timing and timekeeping circuits, a frequency counter, a video-game circuit, music circuits, computer circuits, and some challenges for you, the CMOS logic designer. An appendix with suppliers and addresses is included.

You'll find that this book is one of the most useful and informative books you can get. After reading it, you'll not be able to wait until you can start working with CMOS.

Dennis Keats
Hopkins, MO

Model Railroad Electronics, by James Kyle, TAB Books, Blue Ridge Summit, Penn. 17214. 307 pp., paperback $5.95. 1977.

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THE NEW GAME

by Marshall Ledger

Sperber stepped from the dugout, stood straight and tall for a moment, and glared in the direction of the press box. He raised his clenched fist.

An act of defiance? The team's record surpassed the abilities of the players, so there was no reason to suspect an unfriendly writer. Many people saw the gesture, and few thought of anger.

Sperber ducked back into the dugout and went on with the business of managing.

This entire action took only a moment during a change of hitters. Out of the line-up came the long-ball hitter, Pete Berry. Up to the plate moved Ed Sharkey, scrappy utility man.

The change was not erratic, but it was not Sperber baseball. Grotz the coach noticed it. "You think Berry won't get a piece of it? Sure he's oh-for-three, but might tag one as soon as the next guy."

Sperber looked hard at the coach. Grotz shuffled his feet. "I think nothing." There was a volcano's-worth of suppressed rage in Sperber's tone. "This is not my decision."

Luckily Sharkey didn't have all this on his mind. Coolly he stroked the first pitch toward the right-field corner.

Then came the action of all those hands and feet, that burst of total energy which characterizes baseball. Two baserunners were running for all they were worth. Sharkey tore along, anticipating only a slide into second.

One run crossed the plate, then another. Sharkey wasn't even challenged at second. The stands went wild.

Sperber was up on the steps, pumping the hands of the two who had scored. He flashed a "well-done" to Sharkey, and was cheering along the next batter when it occurred to him that he hadn't been responsible for sending Sharkey up in the first place.

He swiped at a tuft of grass. He glanced at his baffled coach and then bit his lip, as if he had already spoken too much.

Then he jumped back into the swing of the game. He felt his reliever would hold the opposition in the 9th, and he'd be a game closer to first. Momentum and a cunning curve ball did preserve the win. There shortly was noisy joy in the clubhouse.

2

Sperber's gesture raised curiosity. Most eye-witnesses were convinced that he had held his arm up, or simply stretched it, as if an encouragement to Sharkey. Some even said that Sperber, inspired by a sixth sense, was predicting where Sharkey would hit. Parallels were drawn to Ruth's dramatic gesture against the Cubs in the 1932 World Series.

Photographs gradually came forth, taken by both press and public who happened to have had a bead on the dugout as Sperber stepped out. But the photos didn't change opinions. They only buttressed them. People went along thinking what they pleased, now with the support of a picture. The photos gave rise to a few new speculations: Sperber was pointing to threatening clouds, or was simply exercising his muscles, or was objecting to a spectator who was toying with a pocket mirror.

The answer was indeed in the press box, down at the nether end, not an especially good seat for the game (paying fans had better seats), and not even occupied by a member of the press.

Six months earlier, a teen-ager appeared at the club's front office. "May I speak to Mr. Blane?"

"Is he expecting you?"

"I'm applying for the job of team statistician."

The receptionist furrowed her brow. "I don't see that we're looking for a statistician right now," she said, running her eyes over a sheet of paper. "A few part-time secretaries, for vacations that are coming up, and vendors for the season—but for these you apply to the concessionaire.

The kid didn't shy away. "I want to keep the stats. I'm sure Mr. Blane needs good stats. All I want is to talk to him."

Every ballplayer knows that your stats look good when your basic abilities combine with a certain amount of luck. Terry Long came equipped with all his gear to the club office, and his luck appeared in the unexpected shape of Mr. Blane.

His receptionist's perked face made him stop and look at Terry. "Yes?"

If there had been a formal introduction, Terry might have been flustered. Instead, he was almost perfect. "I'd like to speak to you about statistics. About being your statistician."

Blane didn't know about needing one, but waved Terry into his office. The receptionist noted that the door did not re-open even up to the time she cleared her desk for the day. "Is that youngster buying the team?" she joked silently.

He wasn't quite doing that. But when the two emerged from the office, Terry had a new job. And Blane had a new slant on how to run his good, but not outstanding, team.

3

The season began on an upbeat. Rookies took their opportunity with gusto. Veterans pushed harder. Spirit was high, and individual efforts were so outstanding that the team kept winning. The fast start convinced folks that a pennant was likely.

The front office expected a let-down, and it came. The team just wasn't that good, and it slipped to third as the season entered June. It kept pace with the leaders, but consistently was four to six games behind. The fans grew resigned. Only incurable dreamers imagined closing the gap, among them Terry and Mr. Blane.

"Terry, it seems time to make a presentation to Sperber. Are you ready?" Terry held up a sheaf of papers. Here it was, the start of August. The standings had been the same for six weeks. If Terry was to make his move, if he was to earn both his salary and the confidence Blane gave him, then now was the time.

Sperber was called into the top's office. "Hello, George. Terry." He expected to discuss what players might be brought up for September's stretch run. Terry's stats might help in tipping the balance for or against a player or two, but Sperber would rely on good baseball sense. Above all, he wanted that pennant. He too was one of the dreamers.

"Jack," said Blane almost cooingly, "Terry has a ticklish proposition for us."

Sperber looked hard at Terry. His antennae were up at the statistician's opening discussion. For no one doubted his own baseball intuition. Not even the Blue Book out-surmised him. Even though he didn't mull over every Texas-Leaguer, he thought he could pretty well divine the playing potential of a player at a particular time.

Terry, who had planned his presentation, had neglected to frame a tactful opening sentence. He blurted his entire plan at once: "Mr. Sperber, I've fed the stats into a computer and have come up with interesting results. I have a few suggestions to make for future games."

Sperber was mystified, but he smelled interference and recoiled. "Keep to your index cards, son."

Terry tried to protect himself. "That's the old way, sir, an endless row of cards in boxes. I put my stuff on magnetic tape and feed it into a computer and learn interesting things."

As if that were the end of it, Sperber turned his eyes on Blane to get on with the meeting.

"Jack," said Blane, "hear Terry out."

Terry cranked up again and this time made his point. "I love baseball, sir, and feel insulted when people say it's only adults playing a kid's game. I see it differently. I see it as an exercise in problem-solving. I've applied problem-solving techniques to some baseball situations. And what it amounts to is this: the computer tells me to make field decisions that sometimes vary from the ones you make."

Sperber saw light only in the final words, "And I'd like your cooperation in some field decisions."

His reply was long and low, like a tugboat at night: "No."

Blane reached a hand out for Sperber's shoulder. "I promise we won't compromise your status," he said. "You're my manager, and Terry hasn't forgotten that either."

Sperber had worked for Blane long enough to accept his word. He sat down, propped his cheek on his hand, and feigned indifference. But he was listening acutely.

"We need more relations between stats. That's why the index cards aren't enough. They're not much more than batting averages and earned-run averages."

"That's a lot," interrupted Sperber.

"Not enough. We've got to increase what we know."

"We'll drown in knowledge. And lose games not knowing what we need to know." Sperber's negativism forced Terry to be more precise.

"We ask the computer to tell us what we need to know."

"Ask? Ask the computer?" Sperber gave a mocking bow.

"Yes, just as you tabulate how many times X gets on base and Y bunts him to second."

"We do that already. So you can shut down your computer."

"But we want to simulate baseball conditions, not isolated goings-on like bunts."

"Baseball is more than a matter of traffic control."

"Exactly," answered Terry. That's why we want to add human info to the data we already know and use. This isn't done today. Football has game films, but baseball has no equivalent."

"Baseball has dependable spotters, people who know the game," said Sperber harshly.

"Then baseball only compounds human error. I'm trying to reduce the error. The rest of the human component I'd like to program."

"Ever done it?" Sperber challenged.

"I looked at the Tigers-Angels game the other day. The Tigers pitched a right-hander, who figures to beat the Angels. The Angels haven't done well against righties, and this one is hot." Sperber's eyes were glancing down a print-out which Terry had pulled from his stack and plopped into the manager's lap. "But no one has noticed that this righty does poorly at the end of road trips, especially if his previous game was a strong one. He seems to have a let-down. It's all there on paper." Even Blane, to whom this example was new, came from behind his desk to peer over Sperber's shoulder. "The human element. I put it in the form of another stat."

"So what did it tell you?"

"That the Tigers should have gone with their lefty. He was rested."

"Second-guessing."

"Better than not knowing, sir. I'd like to up it to first-guessing. But it wouldn't be a guess. It's just problem-solving."

"Over my rusted cleats." Sperber's mask of calmness began to crack. His job wasn't threatened, but something larger—his whole approach to the sport which was his life. "I won't take orders from you."

That was stated with finality. Terry was scrambling for a mediating sentence. For the first time, he feared the possibility of disrupting a consistent team.

"I used Heisenberg." The tension was so sharp that this new element brought an unseemly guffaw from Blane. Sperber, who was not going to be made the front office's puppet, was not going to be made a fool, either. He tried debunking.

"And what did Heisenberg hit?"

That irrelevance melted the tension, and Terry felt the manager was listening again, although he looked adamant: hands crossed, eyes averted.

"Baseball's a pattern," Terry explained. "The outlines of the pattern are perfectly predictable. In small ranges, unpredictable. Heisenberg developed the uncertainty principle."

"Not by looking at me, he didn't." Sperber shot a wink toward Blane, who wouldn't go along with the derision.

"Yes, he did. He knew he couldn't plot you to the last mental molecule, all the moves you might make. But if I build that uncertainty into the computer simulation, I get a better reading of the moves you might make."

"And this is what you call 'problem-solving.'"

Blane entered at this point. "Man is a problem-solving animal. I'm convinced of that. And I'm convinced, Sperber, that with all the baseball we've both seen, we ignore many of the potential moves. Baseball is surely as rich as chess. But who plays it that way?"

The screws were turning, and Jack Sperber saw who was being pinned. "Good baseball sense is not enough," he said, turning the thought around like a wad of tobacco. The threat was clear to this student of the game who knew baseball by formerly playing and now managing and always observing, analyzing. The computer technician might come up with an equivalent baseball intelligence without ever seeing a game. Wise men could program away without a single blood-cell of commitment. But he was right in there. He liked the press because they attended the games. He could take the occasional boo from a disgruntled fan because the fan came out. There was nothing secretive, cold-blooded, or distanced about it.

"Mr. Sperber, I did my work by coming to the games. I love the sport. And I love computer processes. The computer constructs what is called "real-time." Baseball lives in this real-time. They ought to be brought together. The index cards live in history. That's why they're a faulty guide for the game you are going to play tonight."

"You mean they don't say if my pitcher slept well last night."

"Input that into the computer, and you might change your mind about using him today."

Sperber began to stalk around the office. As Terry ended, he turned to the two men. There was space between them, and for an instant it seemed like a gulf of centuries.

"It's all in the relationships, eh?"

Sperber made a leap even Terry was slow to grasp. The computer results were new relationships among old stats, plus new ones that could be readily assimilated. But human relationships were now being tested and showed signs of strain. These three risked losing human contact. And beyond the personal, they endangered the unity of a team striving to put that little extra into its effort.

Sperber said he'd have to think it over. He came closer and meaninglessly adjusted the chair. "Where did you pick up all this?" he asked.

That was the concession, Terry knew. Sperber would find out about him, have a sense of him, and agree somehow to alter a decision here or there. "My high school was part of a timesharing system with the community college for a computer. I had some free time—you know the last semester of senior high—and put my two hobbies together."

Sperber felt very outdated, more akin now to Blane. He said to his boss, "And so the young generations skip over the years and are smarter than we are before they are half our age." And to Terry: "We have five and a half games to make up. Fish around in your computer for just that much, and you'll make me a believer."

Terry nodded stiffly, frightened for the first time.

4

It was the last of the eighth. The game had see-sawed in score, but now men were on base and the large crowd wanted the team to salt the game away.

If anything seemed unlikely, it was a computer, for this game was essence of baseball. Berry, coming to bat, knew his job. The pitcher, breathing deeply off the mound for a moment, didn't doubt any of his own considerable talent. A clash of Titans, no give either way.

The seconds of relaxation, the apparent listlessness, were a prelude to the instant of truth as the pitch was being delivered. From nothing, a lull which puts off many sports fans, baseball suddenly peaks to the epitome of action. Even the continued peaceful circle of the planets around the sun seems to hang on the outcome of the next split-second as bat and ball engage.

Today Berry was called back and Sharkey sent up instead.

Sperber was surprised by the intrusion. He had put a squawk box on his belt. Terry had another. For a few games previous, they had said things to one another at key moments, but Terry had called no shots. Now Terry was saying, "Send up Sharkey to hit for Berry. Sharkey for Berry."

The voice was like a tap on the shoulder. It couldn't be ignored and in a vague way was expected. But Sperber saw the magic of the game dissolving before that crackling, disembodied, slightly distorted voice from the squawk box.

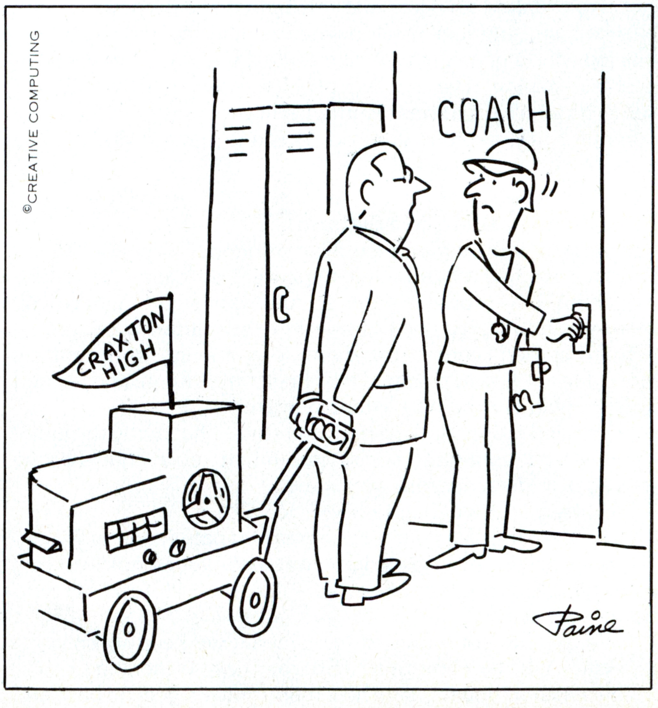
Why Sharkey, he wondered. Does Sharkey come through when there are clouds in the sky? Did Sharkey have spinach instead of string beans for dinner? What little piece of trivia sent the computer into convulsions of recalculation?

Sperber obeyed the voice.

But he had to have his own say. He took a stride that put him instantly at the lip of the dugout and shook his fist, a very heavy weight, toward the far end of the press box.

The gesture of freedom.

Moments later, they were a game closer to first. ■



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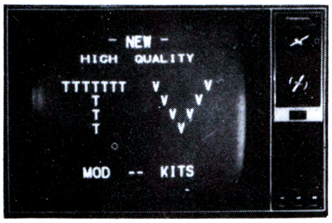

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8400 N PIONEER PKWY
PEORIA IL 61614

KLAUS RADIO INC
905 S NEIL ST
CHAMPAIGN IL 61820

THE NUMBERS RACKET
518 E GREEN ST
CHAMPAIGN IL 61820

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ELECT SUP OF ANDERSON
2228 COLUMBUS AVE POB 1178
ANDERSON IN 46014

GRAHAM ELECTRONICS
133 S PENNSYLVANIA ST
INDIANAPOLIS IN 46204

HEATHKIT ELEC CENTER
2112 E 62ND ST
INDIANAPOLIS IN 46220

HOME COMPUTER SHOP
J BAUGHN
10447 CHRIS DR
INDIANAPOLIS IN 46229

DATA DOMAIN
7027 MICHIGAN RD
INDIANAPOLIS IN 46268

ACRO ELECTRONICS CORP
1101 W CHICAGO AVE
E CHICAGO IL 46312

QUANTUM COMPUTER WORKS
6637 KENNEDY AVE
HAMMOND IN 46323

FT WAYNE ELECT SUPPLY CO
3606 E MAUMEE
FORT WAYNE IN 46803

DATA DOMAIN
RAY BORRILL
406 S COLLEGE AVE
BLOOMINGTON IN 47401

HOBBYTRONIC DISTRIBUTORS
1218 PRAIRIE DR
BLOOMINGTON IN 47401

CASTRUPS RADIO SUPPLIES
1014 W FRANKLIN ST
EVANSVILLE IN 47710

DATA DOMAIN
219 COLUMBIA
W LAFAYETTE IN 47905

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AMAT RADIO EQUIP CO INC
1203 E DOUGLAS
WICHITA KS 67211

COMPUTER HUT
521 N HILLSIDE AVE
WICHITA KS 67214

HEATHKIT ELECTRONIC CTR
5960 LAMAR AVE
MISSION KS 66222

Kentucky

PI BURKS CO
842 S 7TH ST
LOUISVILLE KY 40203

DATA DOMAIN
3028 HUNSINGER LN
LOUISVILLE KY 40220

HEATHKIT
12401 SHELBYVILLE RD
LOUISVILLE KY 40243

CYBERTRONICS
STEVE ROBERTS
312 PRODUCTION CT
LOUISVILLE KY 40299

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506 1/2 EUCLID AVE
LEXINGTON KY 40502

Louisiana

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METAIRIE LA 70005

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KENNER LA 70062

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DAN ELLIS
344 CAMP ST
NEW ORLEANS LA 70130

BAXTERS TV
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BATON ROUGE LA 70809

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COLLEGE PARK MD 20740

THE COMM CENTER
9624 FT MEADE RD
LAUREL MD 20810

HEATHKIT ELECTRONIC CTR
5542 NICHOLSON LN
ROCKVILLE MD 20852

THE COMPUTER WORKSHOP
L & B CHINNERY
5709 FREDERICK AVE
ROCKVILLE MD 20852

BAYNESVILLE ELECT INC
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TOWSON MD 21204

AMATEUR RADIO CENTER
1117 W 36TH ST
BALTIMORE MD 21211

HEATHKIT ELECTRONICS CTR
1713 JOPPA RD
BALTIMORE MD 21234

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902 MAIN ST
N WOBURN MA 01801

HAMILTON AVNET
DAVE DAY
100 E COMMERCE WAY
WOBURN MA 01801

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S & V HALLIGAN
120 CAMBRIDGE ST
BURLINGTON MA 01803

HEATHKIT ELECTRONIC CTR
242 ANDOVER ST
PEABODY MA 01960

COMPUTER MART INC
1097 LEXINGTON ST
WALTHAM MA 02154

TUFTS RADIO ELECTRONICS
386 MAIN ST
MEDFORD MA 02155

HEATHKIT ELECTRONIC CTR
165 WORCHESTER ST
WELLESLEY MA 02181

COMPUTER WAREHOUSE STORE
584 COMMONWEALTH AVE
BOSTON MA 02215

AMERICAN USED COMPUTERS
712 BEACON ST
BOSTON MA 02215

Michigan

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E DETROIT MI 48021

COMPUTER MART INC
1800 W 14 MILE RD
ROYAL OAK MI 48073

GENERAL COMPUTER CO
2011 LIVERNOIS
TROY MI 48084

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JORCHIN HO
245 S WAGNER RD
ANN ARBOR MI 48103

PURCHASE RADIO SUPPLY
327 E HOOVER
ANN ARBOR MI 48104

NEWMAN COMPUTER EXCHANGE
CHARLES NEWMAN
1250 N MAIN ST
ANN ARBOR MI 48104

THE COMPUTER STORE
PETER BLOND
310 E WASHINGTON ST
ANN ARBOR MI 48108

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33610 PLYMOUTH RD
LIVONIA MI 48150

TOP RADIO SUPPLY CORP
17885 MT ELLIOTT
DETROIT MI 48212

HEATHKIT ELECTRONIC CTR
18645 W 8 MILE RD
DETROIT MI 48219

MIDWAY ELECTRONIC SUPPLY
990 W 8 MILE RD
FERNDALE MI 48220

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1035 W TERRITORIAL RD
BATTLE CREEK MI 49015

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MUSKEGON MI 49441

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GRAND RAPIDS MI 49502

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EAGAN MN 55121

HEATHKIT ELEC CENTER
101 SHADY OAK RD
HOPKINS MN 55343

ELECT CENTER COMM DIV
127 3RD AVE N
MINNEAPOLIS MN 55401

Missouri

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13461 OLIVE BLVD
CHESTERFIELD MO 63017

GATEWAY ELECTRONICS INC
LOU ELKINS
8123 PAGE BLVD
ST LOUIS MO 63130

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6903 BLAIR RD
KANSAS CITY MO 64152

Montana

MONTANA COMPUTER CTR INC
2512 GRAND AVE
BILLINGS MT 59102

ELECTRIC CITY RADIO SUP
2315 10TH AVE S
GREAT FALLS MT 59405

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HEATHKIT ELECTRONIC CTR
9207 MAPLE ST
OMAHA NE 68134

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GARY GREEN
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LAS VEGAS NV 89104

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ISELAN NJ 08830

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ALBUQUERQUE NM 87110

COMPUTER SHACK
PETE CONNER
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ALBUQUERQUE NM 87110

MANNIES ELECT & PHOTO
802 S SOILANO DR
LAS CRUCES NM 88001

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COMPUTER MART OF NY INC
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NEW YORK NY 10016

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NEW YORK NY 10011

AUDIO DESIGN ELECTRONICS
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487 BROADWAY STE 512
NEW YORK NY 10013

THE COMPUTER STORE OF NY
BOB ARNING
55 W 39TH ST
NEW YORK NY 10018

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BRONX NY 10458

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H & H SHAIR
200 HAMILTON AVE
WHITE PLAINS NY 10601

HEATHKIT ELECTRONIC CTR
7 RESERVOIR RD
N WHITE PLAINS NY 10603

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6 WOOLEYS LN
GREAT NECK NY 11023

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BOB DANGELO
193-25 JAMAICA AVE
HOLLIS NY 11423

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2072 FRONT ST
EAST MEADOW NY 11554

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AL SMITH
2281A BABYLON TPKE
MERRICK NY 11566

HARISON RADIO
20 SMITH ST
FARMINGDALE NY 11735

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15 JERICO TPKE
JERICO NY 11753

BYTE SHOP LEVITTOWN
JOHN ADAMS
2721 HEMPSTEAD TPKE
LEVITTOWN NY 11756

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185 W MAIN ST
AMSTERDAM NY 12010

TROJAN ELECTRONIC SUP CO
15 MIDDLEBURGH ST
TROY NY 12181

MINIMICROMART
1618 JAMES ST
SYRACUSE NY 13203

SUMMIT DISTRIBUTORS INC
916 MAIN ST
BUFFALO NY 14202

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AMHERST NY 14226

HEATHKIT ELECTRONIC CTR
937 JEFFERSON RD
ROCHESTER NY 14623

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AMATEUR RADIO SLS & SVC CO
2187 E LIVINGSTON AVE
COLUMBUS OH 43209

HEATHKIT ELECTRONIC CTR
2500 MOORSE RD
COLUMBUS OH 43229

ELS SYSTEM ENGINEERING
DAVID BOYLAN
2209 N TAYLOR RD
CLEVELAND OH 44112

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CLEVELAND OH 44113

HELLER ELECTRONICS
2189 LEE RD
CLEVELAND HGHTS OH 44118

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10133 SPRINGFIELD PIKE
WOODLAWN OH 45215

DIGITAL DESIGN
7696 CAMARGO RD
CINCINNATI OH 45243

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JOHN POTTER
45 MURRY HILL DR
DAYTON OH 45403

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1020 W WILSHIRE
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RADIO INC
1000 S MAIN
TULSA OK 74119

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TULSA OK 74135

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BEAVERTON OR 97005

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RICK TERRELL
3482 SW CEDAR HILLS BLVD
BEAVERTON OR 97005

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PAT TERRELL
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PORTLAND OR 97201

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PORTLAND OR 97205

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FRAZER PA 19355

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STATE COLLEGE PA 19711

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HEATHKIT
558 GREENWICH AVE
WARWICK RI 02886

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2018 GREENE ST
COLUMBIA SC 29205

Tennessee

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J & S MORROW
1600 HAYES ST STE 103
NASHVILLE TN 37203

RADIO ELECTRIC SUP CO
961 E SULLIVAN
KINGSPORT TN 37662

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3449 KINGSLEY RD
GARLAND TX 75041

KA ELECTRONICS SALES
1117 S JUPITER RD
GARLAND TX 75042

MARTIN WHOLESALE ELECT
BOX 588 6 TERRACE SHOP CTR
RICHARDSON TX 75080

THE MICRO STORE
DAVID WILSON
634 S CENTRAL EXPWY
RICHARDSON TX 75080

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2715 ROSS AVE
DALLAS TX 75201

ELECTRONICS CENTER INC
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DALLAS TX 75204

TANNEI ELECTRONICS
11423 HARRY HINES
DALLAS TX 75229

COMPUTER SHOPS INC
WARREN WINGER
NORTHCENTRAL EXPWY
DALLAS TX 75231

KA ELECTRONIC SALES
1220 MAJESTY DR
DALLAS TX 75247

ARLINGTON ELECTRONICS
915 E PARK ROW
ARLINGTON TX 76010

AMT ELECTRONICS PARTS CO
500 S CHARLES ST
ELM MOTT TX 76640

MADISON ELECT
1508 MCKINNEY
HOUSTON TX 77002

ELECTROTEX
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HOUSTON TX 77006

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HOUSTON TX 77027

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9305 D HARWIN DR
HOUSTN TX 77036

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BILL TATROF
7231 FONDREN RD
HOUSTON TX 77036

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5750 BINTLIFF DR STE 206
HOUSTON TX 77072

THE BIT BAM
1111 BURKF 313
PASADENA TX 77506

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SAN ANTONIO TX 78216

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SALT LAKE CITY UT 84105

BYTE SHOP SALT LAKE CITY
S & B BOLLINDER
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SALT LAKE CITY UT 84111

MANWILL SUPPLY CO
2780 S MAIN ST
SALT LAKE CITY YT 84115

BALLARD SUPPLY CORP
2430 S 900 W
SALT LAKE CITY UT 84119

CENTRAL UTAH ELEC SUPPLY
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PROVO UT 84601

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ARCADE ELECTRONICS INC
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ANNANDALE VA 22003

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SPRINGFIELD VA 22150

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ALEXANDRIA VA 22314

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4503 W BROAD ST
RICHMOND VA 23230

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W WITSCHEY
1905 WESTMORELAND ST
RICHMOND VA 23230

COMPUTER HOBBIES UNLIMITED
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9601 KENDRICK RD
RICHMOND VA 23235

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1055 INDEPENDENCE LBVD
VIRGINIA BEACH VA 23455

ELECTRONIC SALES INC
100 W MERCURY
HAMPTON VA 23669

Washington

KBC COMPUTER SHOP
2735 152 AVE NE
REDMOND WA 98052

AMATEUR RADIO SUPPLY CO
6213 13TH AVE S
SEATTLE WA 98108

ALMAC STROUM ELEC
GARY HOWLETT
5811 6TH AVE S
SEATTLE WA 98108

RETAIL COMPUTER STORE
T & S BROOM
410 NE 72ND ST
SEATTLE WA 98115

HEATHKIT ELEC CENTER
2221 3RD AVE
SEATTLE WA 98121

AMERICAN MERCANTILE CO
2418 1ST AVE S
SEATTLE WA 98134

PACIFIC COMPUTER STORE
410 W CHAMPION ST
BELLINGHAM WA 98225

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6009 B 13TH WAY SE
OLYMPIA WA 98503

THE COMPUTER SHOP
RALPH SCOTT
W 621 FIRST AVE
SPOKANE WA 99204

West Virginia

BUSINESS COMPUTER SVC
1027 VIRGINIA ST E
CHARLESTON WV 25301

THE COMPUTER STORE
STEPHEN PAYNE
1114 CHARLESTON NATL PLZ
CHARLESTON WV 25301

Wisconsin

CHESTER ELECT SUPPLY CO
1220 60TH ST
KENOSHA WI 53140

ITTY BITTY MACHINE CO
2221 E CAPTIOL DR
SHOREWOOD WI 53211

MILWAUKEE COMPUTER STORE
6916 W NORTH AVE
MILWAUKEE WI 53213

AMATEUR ELECT SUP INC
4828 W FOND DU LAC AVE
MILWAUKEE WI 53216

HEATHKIT
5215 FOND DU LAC AVE W
MILWAUKEE WI 53216

SATTERFIELD ELECT INC
1900 S PARK ST
MADISON WI 53713

MICROCOMP
NYLES PRIEST
785 S MAIN ST
FOND DU LAC WI 54935

Wyoming

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120 EL DORADO CT
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1108 LOGAN AVE
CHEYENNE WY 82001

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3515 18TH ST SW
CALGARY AB CAND

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CALGARY AB T2T 4J5

MICROTRONICS
1202 525 75TH AVE SW
CALGARY AB T2V 1R8

BYTE SHOP VANCOUVER
M & J MCKAY
2151 BURRARD ST
VANCOUVER BC CAND

B W KLATT
MICROTRONICS
R R 1
OLIVER BC V0H 1T0

HEATHKIT ELEC CENTER
3058 KINGSWAY
VANCOUVER BC V5P 5J

THE PACIFIC COMPUTER STR
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VANCOUVER BC V5R 2J4

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69 GLOUCESTER ST
TORONTO OT M4Y 1LB

THE COMPUTER PLACE
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TORONTO OT M5V 1Z1

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TORONTO OT N5M 3Y7

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MONTREAL PQ H3C 1G2

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L M GRIFFIN
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REGINA SK S4S 6J4

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ENTRYPHONE CO LTD
172 I FIELD RD
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TRAVESERA DE GRACIA 48
BARCELONA 6 SPAIN

COMICRO AG
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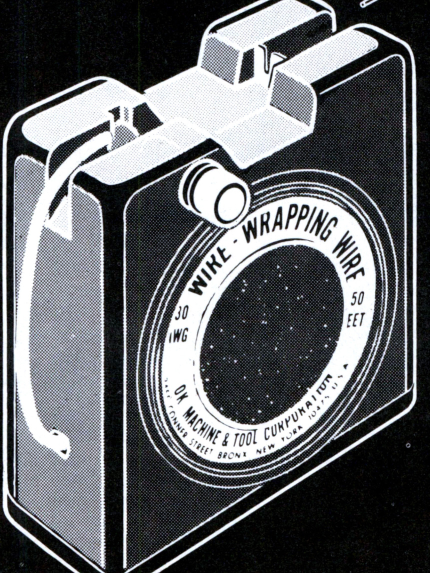
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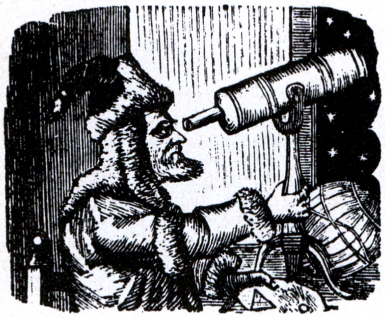


Spinrad's Galaxy

A Berkeley astronomer named Hyron Spinrad recently identified a super-giant eliptical galaxy which he predicts is at least half the age of the universe. It is, claims Spinrad, the most distant stellar object of its kind yet found.

Known for the last 20 years as an intense radio source in the autumn sky north of the Pleiades, the galaxy, designated as 3C123 on star maps, has finally appeared as a dim spot on a computer-processed photograph. The cluster contains thousands of billions of stars and perhaps three sister galaxies whose light has been traveling through space for *eight billion years*—about half the estimated age of the universe.

Prof. Spinrad discovered the object by utilizing a new computerized "image tube scanner" system, which collects spectroscopic data over several nights of observation and then subtracts the "glare" (actually brighter than the image itself) effects of background light. The scanner system is attached to the 120-inch telescope at the University of California's Lick Observatory.

Computer Projects 21st Century Hunger Chaos

CLEVELAND—(UPI)—A computer survival program at Case-Western Reserve University, capable of plotting for many years in advance the economic fortunes of nations, forecasts world chaos in less than a century because of food shortages.

Six private foundations have provided $790,000 in funding for the university computer center to develop computerized programs that would help countries avoid economic disaster.

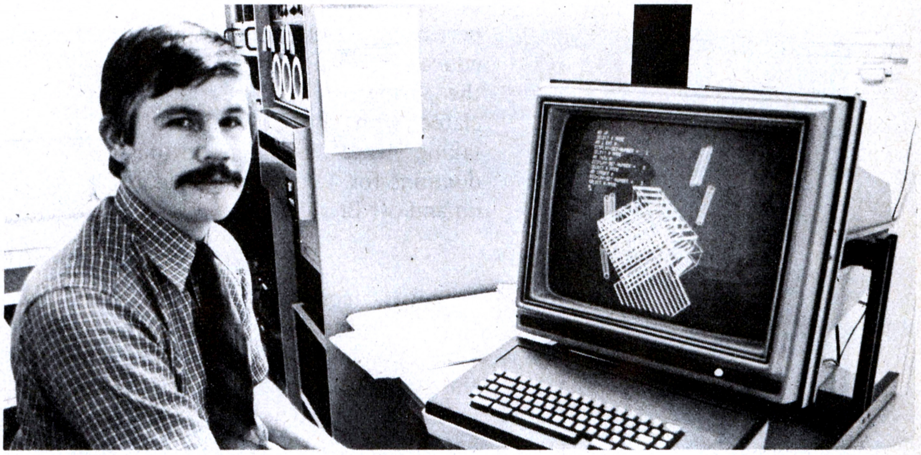
Prof. Mihajlo Mesarovic said the school is bidding to become the world center for computer planned survival of some of the major nations bordering the Pacific Ocean.

Graphics Display System

Combining the features of an automatic draftsman and a versatile computer, with unlimited capabilities for enhancement of the human imagination, is the Spar/Graphics Display System, from Scientific Process & Research, Inc.

This system, for example, can be of assistance to designers of artwork, logos, and layouts, utilizing computer graphics, interacting to offer selective choices in great variety. Small patterns can be created, then displayed in any combination to determine overall effect. Thousands of *any* combinations can be tested in the time it takes to draw a single image or pattern. Complex patterns or concepts can be self-generated by the system to expand the user's own imagination. Complex objects and shapes can be created, altered, copied, repeated, enlarged or multiplied.

Points, lines, curves, unusual or complex shapes are displayed on the screen. A single command duplicates the figure, if desired. Another will move it or enlarge it, reduce it, or rotate it. Three-dimensional effects can be added, as well as new features, at any stage. Designs can be named and recalled easily. Moreover, several figures or concepts can be combined and given a new name. One can display hundreds of designs, drawings, or graphs, in minutes, and select the one wanted, then print it. Draw one element, and in seconds, a whole pattern is generated. Elements can be altered, rotating some, enlarging other. Forms or figures can be stored, even entire patterns or layouts, by a single command on a magnetic disk included with this system, which is from Scientific Process & Research, Inc., 24 North Third Ave., Highland Park, NJ 08904.



Computers in Architecture

The time is coming, and it may be in the very near future, says Charles Eastman, when the computer will become as common an architectural design tool as the T-square and triangle.

Eastman, a professor of architecture, computer science and urban affairs at CMU, can sit down at a console and by giving the right commands, call up various drawings of a building to a computer driven TV screen and make changes in the building's configuration.

It only takes a minute or two, for instance, for Eastman to call up on the screen, any plan, section, evaluation or perspective of the University's administration building, a six-story office complex. The computer can provide perspective or orthographic displays of the structural elements, exterior panels, plumbing, mechanical equipment or interiors, for example. Any number of elements such as the heating system ductwork can be added or subtracted by pressing a few keys.

Eastman's system would not do away with the traditional architect's function of design; he would still have to use his technical and aesthetic judgment. "A great part of the architect's cost now is in the time it takes to produce the drawings," says Eastman. "If we can get a computer to produce those detailed drawings, it will cut down drastically on the time and, therefore, the cost of an architect's work."

Eastman says housing developers might find they can offer custom built homes instead of houses that all look alike. "The possibilities are that you could sit down at a computer terminal and work out a custom designed house with drawings, parts lists and possibly even construction schedules prepared automatically."

—Carnegie-Mellon Alumni News

Cal Students on Leave Program to Work at IBM

Selected computer-science students at the University of California at Berkely have been taking half-year leaves of absence from college to gain work experience with computers at IBM's San Francisco Data Center. Called the Co-op Program, the work program is designed to give the students an opportunity to apply their classroom knowledge to meaningful and real jobs with IBM's Data Processing division.

"The students work on real problems and provide a valuable assist to our regular staff," said Earl Ness, manager of IBM's San Francisco Data Center. "At the same time, the students gain solid work experience and earn pay to help with their college expenses."

Whither Computers?

Despite heavy investment and numerous successful experiments with computerized instruction techniques in school systems nationwide, "computers have failed to make more than a minimal impact on education"—primarily because of financial constraints, according to Robert G. Scanlon, executive director of Research for Better Schools, Inc.

This was the apparent consensus of computer companies assembled recently in Washington, D.C. for the First International Learning Technology Conference. After a decade of trying to get into the public education business, most companies have decided to temporarily forego public education and concentrate instead on business.

In an article in *The Washington Star* (July 23, 1976), Scanlon was quoted as saying that in the 1960s the federal government invested nearly $100 million in experiments to promote electronic teaching devices. While teachers and administrators endorsed use of computers, "when the funds ran out, school after school returned to the old way of doing things."

Computer companies now hope that as more and more businesses install computers to train employees, public schools will eventually see electronic technology as an economical approach to teaching.

—The Science Teacher

Computer Game Helps Students Understand Congress

Out-guessing the US Congress with the help of a computer can be fun and educational too. Designed for secondary- and college-level students, "The Congressional Game" was developed by a Univ. of Pennsylvania professor, Dr. Robert Zemsky, and the Uni-Coll Corp., a Philadelphia computer utility.

With the new program, the history student can simulate what it was like to be sitting in Congress a century ago. At that time, Grant was President and the Congress was debating the Korean seizure of an American naval vessel, civil rights, import tariffs and federal subsidies for railroads. The game was developed with two purposes in mind— to help students understand how Congress works and to help them understand how historians work.

The program presents the student with various authentic historical facts and constantly engages the student in the selection, evaluation and use of the information to develop a hypothesis regarding the outcome of a roll-call vote. The winner is the student who has the most success in refining the hypotheses about how the House will act when seen at a realistic, daily level.

Brain Monitor

The psychology department at De Anza Community College in Cupertino, California, uses a Hewlett-Packard RTE-II minicomputer system to teach classes in data processing and statistics, and to help conduct laboratory-based psychological experitory-based psychological experiments, including human and animal learning and cognition. The RTE-II system, through an analog-to-digital converter, receives information from a number of physiological and biofeedback testing devices.

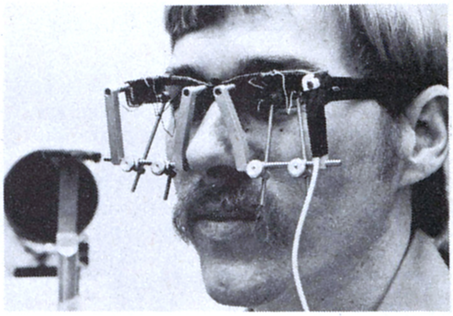
In experiments with humans, the RTE-II system is involved in biofeed-back. Through interfaces, it collects information on, correlates and plots the heart rate, galvanic skin response, EEG readings and temperature of each subject. In the photo, Frank C. Savage, professor of psychology, conducts computer-based measurements of the brain-wave activity of Thomas D. Carrell, senior psychology technician.

Computer Check at the Border

As automobiles stop at the customs checkpoint in the sleepy village of Roma, Texas, few drivers realize that their license-plate numbers have been keyed into a U.S. Treasury Department computer 1,200 miles away in San Diego.

Within seconds, customs inspectors know if the vehicles have been stolen and whether their owners are suspected of involvement in a crime just about anywhere in the world.

Similar facilities are located in other cities along the Mexican border, which are also linked by a voice circuit.



Eyes Tracked by Computer For Hints of Disease

A new eye-movement monitoring device, developed by a Carnegie-Mellon University biomedical engineering professor and three physicians at Pittsburgh's Eye and Ear Hospital, may eventually detect crippling diseases in their early stages.

The Optical Data Digitizer, or the "ODD Tracker," is a camera interfaced with a minicomputer which scans across the eye and notes the position and vertical/horizontal motion of the eye. "It's biggest advantage is that you don't have to touch the patient," says Dr. Bahill.

Watching the eyes is an increasingly important way of determing the health of the patient. "The eyes are the windows to the brain," says Dr. Bahill, who first became interested in eye movements while a graduate student at the University of California at Berkeley.

Dr. Bahill contends that the brain and eye work on a "time optional system" where the brain focuses the eye on an object and shifts it to another object in the least amount of time. He believes that persons suffering from diseases develop abnormal eye movement patterns. These patterns are often the first symptoms of such diseas as Multiple Sclerosis, a degenerative disease of the central nervous system; Parkinson's Disease and Huntington's Chorea, two muscular disorders accompanied by tremors, and Duane's Syndrome, a form of eye paralysis. For example, the ODD Tracker shows persons suffering from Multiple Sclerosis will fall short of a target with one eye and over-shoot the same target with the other eye.

Computer Controls Drug Quality

Drug quality and consistency tests at Miles Laboratories in Elkhart, Indiana, are being performed for the first time with the help of a small IBM computer. The System/7 enables quality-control chemists to do more extensive testing, in a shorter time, on clinical test reagents and on a variety of Miles products, which include Alka-Seltzer, Bactine, Chocks and One-A-Day vitamins.

The System/7 is linked to instruments such as auto analyzers, gas chromatographs and amino-acid analyzers to test for such things as stability and consistency of product ingredients.

Before the system was installed, instrument readings were recorded and analysed manually, which took half a day for testing and the rest of the day for comparative analysis. Now the tests are performed throughout the day and results are known minutes later. At the same time, the system eliminates costly transcribing errors that plague manual testing operations.

Outsmarting Computers is Profitable Hobby for Floridian

WINTER PARK, Fla—Tired of stamp collecting? Try outsmarting computers for a hobby, the way Christopher Cossette does.

A computer hobbyist with a different idea, Cossette proves the fallibility of computer systems - any computer system. And so far he seems very good at his hobby.

Cossette claims to be able "to get in anybody's program with a few telephone calls." Such companies as Exxon, Master Charge and Bank of America all have the same inaccuracies built into their systems, he said, although he refused to disclose any further details.

In 1974, Cossette obtained $110,881 from a Canadian department store over several months' time. It took him a while to convince the company what was happening and, in the meantime, he earned enough interest from the money to pay for a sports car and a swimming pool.

By working at his avocation, Cossette also managed to acquire three credit cards against which nothing is ever billed, he said. Airlines have credited him for tickets he never bought and stores have sent him duplicates or triplicates of items without charge.

Cossette, who claims to have done nothing illegal, does not think highly of the computer industry and accused it of "gross negligence."

"Computers are no smarter than the people who program them, and that quality must have fallen off recently," he said.

"I think the industry has improved on the Peter Principle," he added. The Peter Principle is the concept which states that workers rise to the level of their incompetence.

For those panting to take up the hobby, Cossette is publishing a book on the subject, which will disclose how he managed his success.

—Computerworld

Sewing Machine Uses Microcircuit

A custom-designed microelectronic circuit has made possible a home sewing machine that has more sophisticated sewing features, is easier to use, and contains 350 fewer mechanical parts than conventional models. The microcircuit permits the Athena 2000 sewing machine by Singer to be programmed with control buttons to sew basic practical and complex decorative stitch patterns, repeat a single pattern unit and stop, and do buttonholes completely automatically. Circuitry on the chip coordinates needle and fabric movement for optimum width, length, and density of 24 stitch types. Safety logic circuits help prevent damage to the needle and the machine.

The LSI/MOS chip contains 2,000 transistors and was produced by American Microsystems. The chip is primarily a ROM that permanently stores the instructions for sewing the 24 different patterns.

According to Jack Wurst, Singer manager of electronic development, "To duplicate the Athena 2000 machine using mechanical systems instead of electronics would be practically impossible. It could be done; it would be an extremely large, cumbersome, and expensive machine."

You can subscribe by phone to Creative Computing by calling Linda at 800-631-8112.

Computer Helps Feed Cows

Cows on a Dutch model farm are reported to be healthy and happy after a year's trial of a computer-based feeding system developed by the DACA Electronic Engineering and Contracting Company of Leystad. The system was developed to solve the feeding problems of large dairy farms, where some cows need more feed supplement than others. A transmitter attached to the cow's collar sends a signal, via a receiver in the cow's manger, to a computer that checks stored data and decides whether she needs any supplement at the time. If Daisy's milk production has been low she receives a predetermined quantity of supplement.

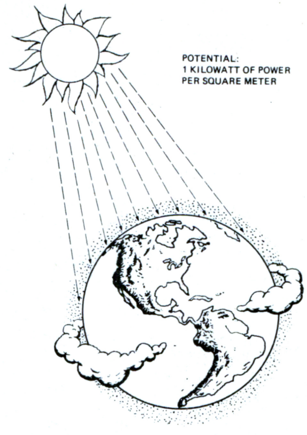
Computer Helps Archeologists Unearth Pre-Historic Communities

Computer technology has joined the pick, shovel and drill to help Northwestern University archeologists at the largest excavation site in North America. Archeologists working at the Koster site in southern Illinois rely on a Control Data 6400 computer 300 miles away at Northwestern University to keep track of their findings and even determine where to begin the next excavation.

In addition to information unearthed at the Koster site, pertinent data recovered from some 800 different archeological sites in the 2,800-square-mile research area is entered through a terminal for relay to the CDC computer. At Northwestern's Vogelback Computing Center, the 6400 uses a university-developed data-base program known as RIQS (Remote Information Query System), designed to handle the varied data of individual researchers.

From information entered on terminals at the excavation headquarters, the CDC computer built a file for each of the 800 sites. Each file is structured to hold 145 items of information about the site and the excavation results. Site description includes name, location and size of the excavation, names of the archeologists involved, where the artifacts from the site are stored, and what has been photographed.

The survey information sent to the computer relates to soil conditions, evidence of cobbles and limestone (indicates cooking, pottery and tool making) and of animal bone (means there is favorable preservation at the site). Of the 145 slots of information storage for each site, 123 are for listing the artifacts uncovered—the data most important to archeological analyses.



IBM Scientists Apply Computers to Harvesting Solar Energy

With a limitless and free source of energy staring us in the face, why is humanity relegated to digging holes in the earth in an effort to find enought fuel to power society? Spurred by shortages of fossil fuels and an ever-increasing need for more energy, scientists are now using the most sophisticated tools available to answer this question-to explore the obstacles that have thus far prevented mankind from efficiently harvesting solar energy for widespread use.

At IBM Corporation's Palo Alto Scientific Center, research specialists have initiated solar-energy studies by applying powerful computers to the problems of tapping the sun as a widespread and economical source of energy.

Between 10 and 50 percent of the light reaching the earth's surface is indirect, diffused sky light—depending upon atmospheric conditions—rather than direct sunlight. "We know something about the characteristics of diffused sky light energy, but not enough for efficient harvesting," said IBM's Dr. J.V. Dave, a radiation specialist. "Scientists hope to develop ways to harvest diffused sky light in conjunction with direct sunlight. But before that can occur, it is essential that we learn more about the nature of sky light energy."

At best only about 10-12 percent of the solar energy reaching a given spot on the earth can be harvested. That's because the sun's energy is spread over different wave lengths and no solar cell can capture all forms--from infrared or heat energy to near ultraviolet energy. To manufacture cells that capture even 20 percent of the available solar energy becomes prohibitively costly.

Because of their ability to stimulate reality and to solve gigantic and complex mathematical problems, computers are viewed by Dr. Dave and other scientists as valuable aids for learning more about solar energy. Dr. Dave hopes to simulate characteristics of sky light energy under representative atmospheric conditions and study their impact on solar cells. The results of such experiments and simulation studies could then be used by others who are exploring various alternatives to be considered in advance of designing and building actual solar-energy plants.

Computer-Error Merchandise

The *Saturday Review* classified ads now include a section on "Computer-Error Merchandise" which has offered, among other things: several hundred bicycles with handlebars fore and aft; a similar number of plastic shampoo bottles mistakenly filled with vichyssoise; and 38,000 copies of "Mein Kampf" in Polish, minus vowels.

MEDPA Newsletter

Mind-Reading Machine

The government is developing mind-reading machines that can show, among other things, whether a person is fatigued, puzzled or daydreaming. If the project lives up to its promises, the machines could be installed in airplane cockpits in a few years, to warn the pilot that his mind is wandering and he is not performing essential duties.

Since 1973, the Advanced Research Projects Agency at the Pentagon has been studying ways to plug a computer into a person's brainwaves. So far, scientists have been able to determine a person's alertness, and how he perceives colors and shapes. Current research is on the use of brainwaves to control machines.

Other research is aimed at using brainwaves to discover how a student learns and when he is most likely to learn, and also to improve computer-based teaching programs.

So What's the Bad Word?

English suffers endless indignities, but it does not suffer in silence. Some 12 years ago, the publishers of the American Heritage Dictionary, seeking protection in numbers, collected together a group of 150 authors, critics, editors, historians, etc. and dubbed them the "Usage Panel." The Feb. 24 *New York Times* reported some of their comments to the latest atrocities, two of which are reprinted below.

Is it acceptable to use "free up," as in "a new copying machine that will free up your secretary"?

J.K. Galbraith, economist: "Indecent, even obscene."

Jacques Barzun: "She's a loose woman already."

Nat Hentoff, author: "I think there's a chance of nipping this one. It should be shunned up."

"Input" is used as equivalent to "data or information" in charting a course, as in "The President had access to varied input," and to "an active role" as in "The nominee declared that he had no input in adoption of the plank." Yes or No?

Jacques Barzun: "...jargon—and very vague, since input can mean anything from a Congressional appropriation to a frankfurter at lunch."

Nat Hentoff: "...mechanical shorthand that rusts thought."

Bruce Catton, historian: "...particularly offensive form of the social science jargon."

John Fowles, author: "A Watergatism (mechanistic barbarism)!"

Lewis Mumford, author: " 'Input' has a legitimate use in computerdom— otherwise it should be shunned. It is the equivalent of 'y'know' for those who don't know the right word."

Berton Roueche, author: "I accept 'output,' but—I don't know why— 'input' turns my stomach. Maybe it's the people who use such words."

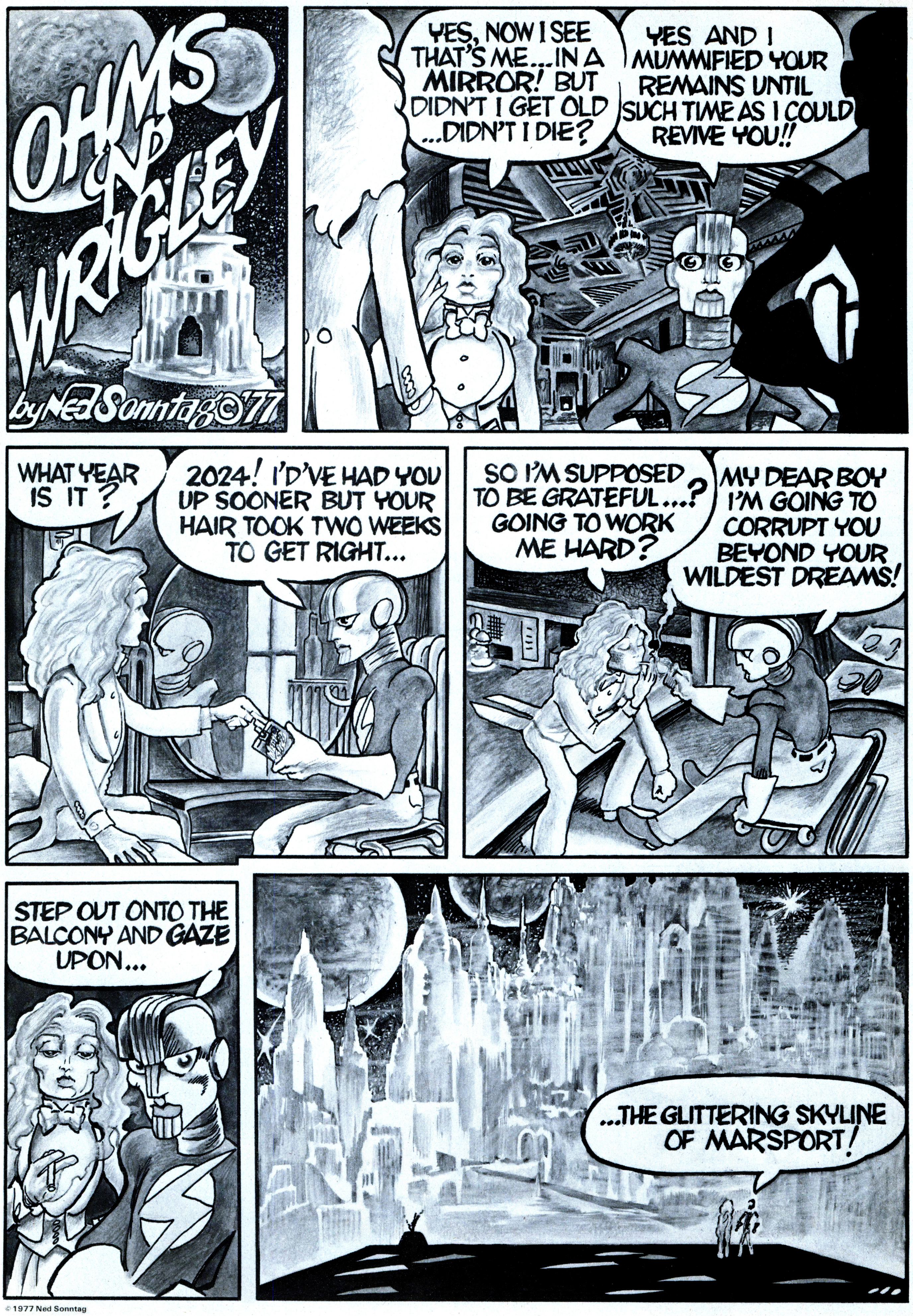
Pierre Berton, author: "I do not mingle socially with people who talk this way and would not expect my readers to stick with me if I used it."

Reuven Frank, television producer, voting no: "If there is output there must be input. If there is outcry there must be incry. If there is outlaw there must be inlaw. So the reasoning is junk."

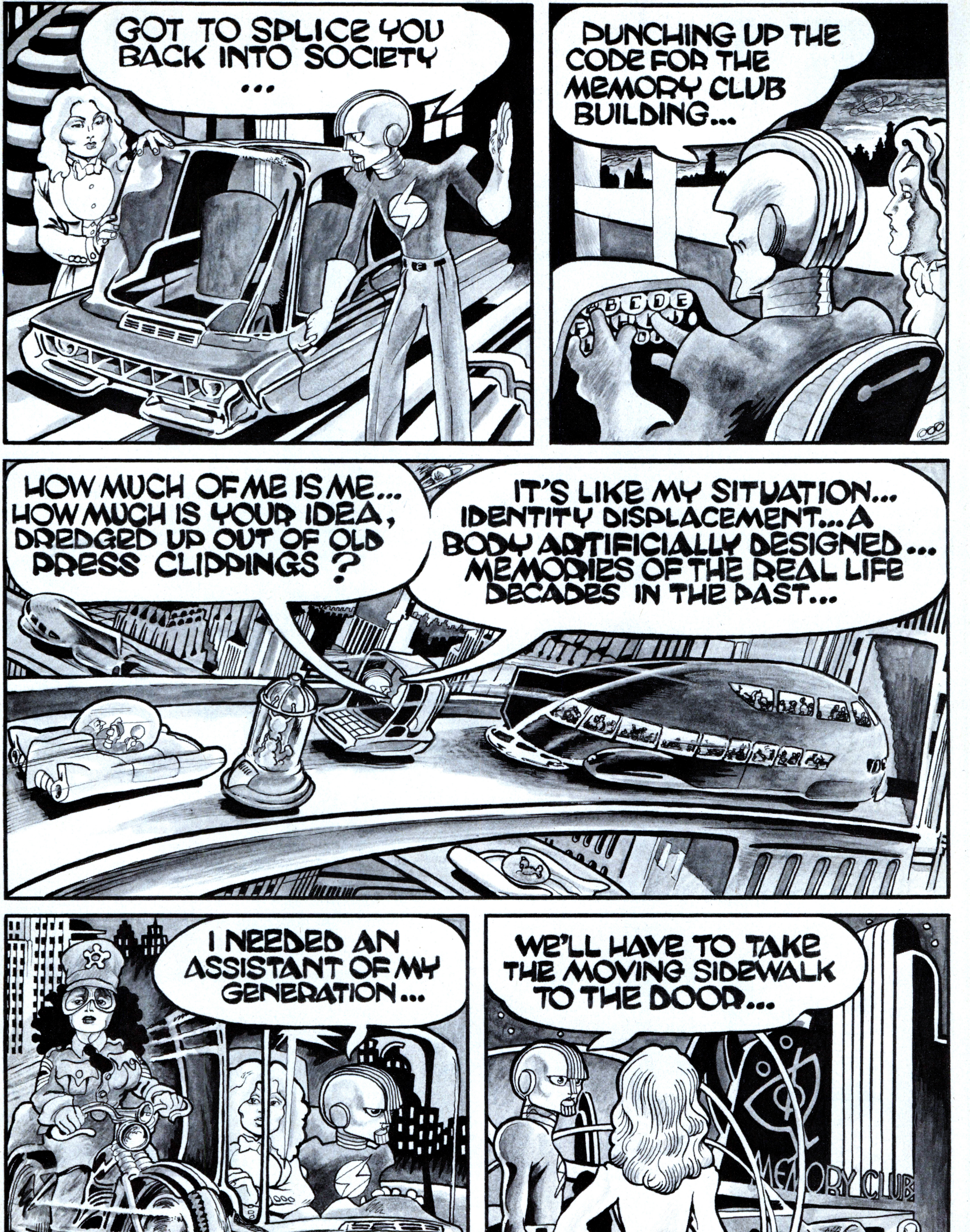
Gilbert Highet: "...carries an objectionable image of a politician as a sort of I.B.M. machine passively receiving whatever people stuff into his slots."

Peter De Vries: "...the thought of putting information into a President is a little grotesque."

Red Smith: "This usage brings a violent output of nausea here. Couldn't the President have access to advice instead?"


OHMS 'N' WRIGLEY
by Ned Sonntag ©'77
YES, NOW I SEE THAT'S ME....IN A MIRROR! BUT DIDN'T I GET OLD ...DIDN'T I DIE?
YES AND I MUMMIFIED YOUR REMAINS UNTIL SUCH TIME AS I COULD REVIVE YOU!!
WHAT YEAR IS IT ?
2024! I'D'VE HAD YOU UP SOONER BUT YOUR HAIR TOOK TWO WEEKS TO GET RIGHT...
SO I'M SUPPOSED TO BE GRATEFUL....? GOING TO WORK ME HARD?
MY DEAR BOY I'M GOING TO CORRUPT YOU BEYOND YOUR WILDEST DREAMS!
STEP OUT ONTO THE BALCONY AND GAZE UPON...
...THE GLITTERING SKYLINE OF MARSPORT!

© 1977 Ned Sonntag


GOT TO SPLICE YOU BACK INTO SOCIETY ...
PUNCHING UP THE CODE FOR THE MEMORY CLUB BUILDING...
HOW MUCH OF ME IS ME... HOW MUCH IS YOUR IDEA, DREDGED UP OUT OF OLD PRESS CLIPPINGS ?
IT'S LIKE MY SITUATION... IDENTITY DISPLACEMENT... A BODY ARTIFICIALLY DESIGNED... MEMORIES OF THE REAL LIFE DECADES IN THE PAST...
I NEEDED AN ASSISTANT OF MY GENERATION...
WE'LL HAVE TO TAKE THE MOVING SIDEWALK TO THE DOOR...
MEMORY CLUB

TO BE CONTINUED...

BACKGAMMON

Chuck Snow

This program plays a game of backgammon with a human player through the terminal. What follows are annotated excerpts from the program which outline the principles it employs.

P and C$

There are 28 positions arranged as illustrated in diagram # 1. Positions 1-24 are the board positions. The human player is White and the program is Red. Positions 19-24 are White's inner table. Position 25 is the position to which White moves at the end of the game when he bears his men off the board. Position 27 is White's bar; when a white man is taken by Red he is sent to position 27 from which he must reenter the board in order to be in play again.

Similarly positions 1-6 are Red's inner table, 0 is the position to which red men are born off the board, and position 26 is Red's bar.

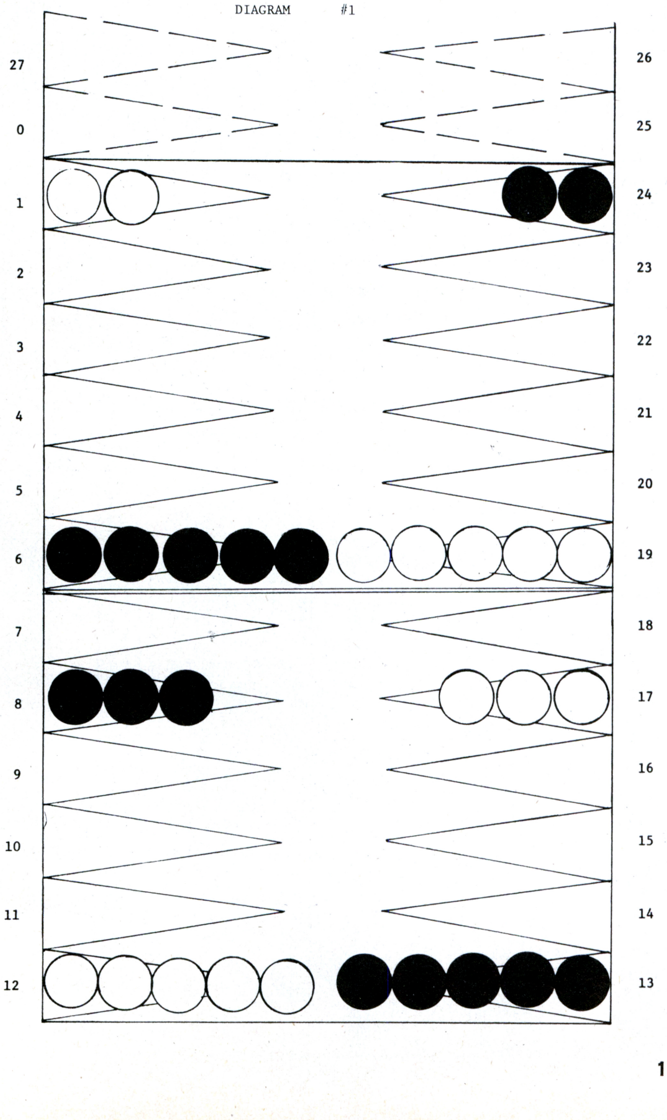
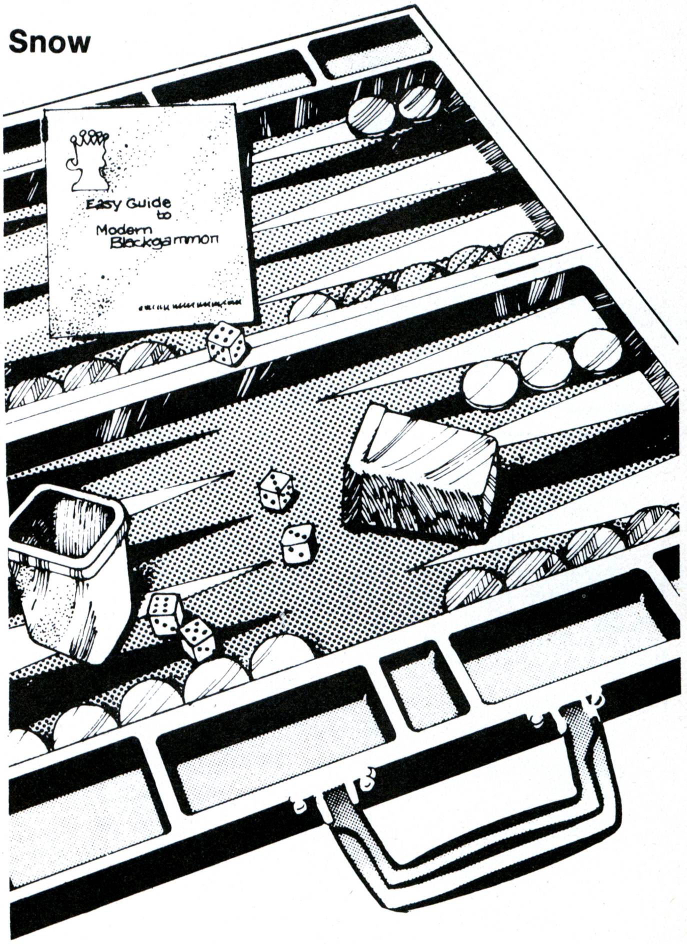


DIAGRAM #1


Easy Guide to Modern Backgammon

All moves, file manipulations, and strategies in the program are accomplished through two functions: P and C$.

P is a function whose domain is the set of integers 0-27 and whose range is the set of integers 0-15. It tells how many men currently occupy a given position. For example in diagram # 1, P(1)=2

C$ is a string function whose domain is the same as P's and whose range is the set ["RED", "WHITE", SPACE$(5)]. It tells whether a given position is occupied or not and if so by whom. For example in diagram #1, C$(1)="WHITE".

How the men are moved

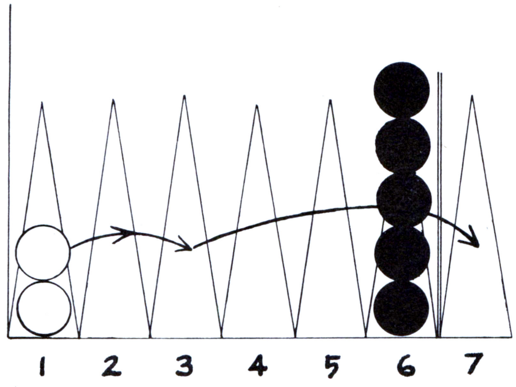
Suppose the human player (White) throws the dice, and the die results are 2 and 4, and he wants to move the 2 men on position 1. The program requests on INPUT of I and J. I is the position from which the move is to be made, and J is the number of positions to be moved forward from I. J must be one of the die results.

White types "1,2 (RETURN)". The program decreases P(1) by 1 and increases P(3) by 1.

White then types "1,4 (RETURN)" and the program decreases P(1) by 1 more, so that P(1) is now zero, and increases P(5) by 1.

Chuck Snow, 2401 Freeport Street, Wantagh, NY 11793.

DIAGRAM #2



When P(1) is set to zero, C$(1) is set to SPACE$(5), indicating that position 1 is now unoccupied.

The statements involved are:

```
6610 P(I)=P(I)-1
6620 IF P(I)>0 THEN 6700
6630 C$(1)=SPACE$(5)
6700  I=I+J      ' I IS NOW THE POSITION TO
        WHICH WHITE IS MOVING
6750 P(I)=P(I)+1
```

If white wants to move only one of the men on position 1 a total of 6 places forward he types "1,2 (RETURN)", moving one man to position 1+3=3, followed by "3,4 (RETURN)", moving the same man to position 3+4=7. See diagram # 2.

Accommodating the rules of the game

One of the rules of backgammon is that a player may not move a man to a position occupied by 2 or more of his opponent's men. He may however move to a position occupied by one of his opponent's men, and in this case the opponent's man is removed from play and "sent to the bar." The opponent must now reenter this man upon the board before he can resume playing.

Let's assume that it is White's turn and that board positions 7-12 are as pictured in diagram # 3. One of White's die results is 3 and he moves one of the men on position 8 to position 11. How is this rule of backgammon implemented?

The program prints the appropriate message ("RED MAN TAKEN ON POSITION # 11. PUT HIM ON THE BAR."). does *not* change P(11) (because it is still occupied by one man), increases P(26) by 1 (position 26 is Red's bar), and changes the possession of position 11 from "RED" to "WHITE".

The statements involved are:

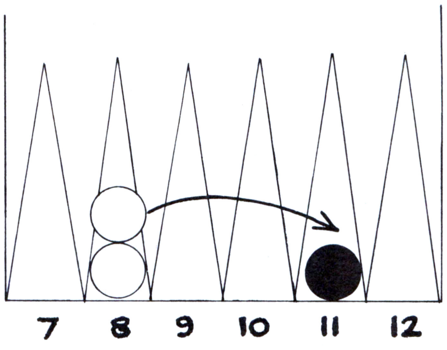
```
6700  I=I+J      ' I IS NOW THE POSITION TO
        WHICH WHITE IS MOVING
6710 IF C$(I)<> "RED" THEN 6750
6720 P(26)=P(26)+1
6730 PRINT "RED MAN TAKEN ON POSITION # "I
        " PUT HIM ON THE BAR."
6740 GO TO 6760
6750 P(I)=P(I)+1
6760 C$(I)="WHITE"
```

White's referee

It is possible for White through either malice or error to input an illegal move. For example suppose in diagram #3 White wants to take the vulnerable red man on position 11 but erroneously types "9,3 (RETURN)". The error is of course that White does not have any men on position 9.

I found it desirable to let a portion of the program be a one-sided referee; assuming no programming errors, Red should never violate a rule of the game, so it is necessary only to monitor White's moves for errors.

DIAGRAM #3



One part of White's referee scrutinizes White's input before control is given to the part of the program that executes White's proposed move. This part of the referee simply checks to see if position I is occupied by White. If it is not it issues an appropriate error message and requests that the input be corrected.

```
4630 INPUT I,J
6000 REM WHITE'S REFEREE
6190 REM IS I OCCUPIED BY WHITE?
6230 IF C$(I)="WHITE" THEN 6270
6240 PRINT "WHITE DOES NOT POSSESS POSI-
        TION # "I
6250 PRINT "TRY AGAIN."
6260 GO TO 4630
6270 REM NEXT PART OF WHITE'S REFEREE
```

The playing loop

The playing loop is the part of the program that throws the dice and gives control to the appropriate player.

F$ is a string variable whose domain is the set ["RED, "WHITE"]. It tells whose turn it is.

D(1) and D(2) are the die results. Their values are determined by a scaled RND function described below.

M is the number of moves the current player has. In backgammon if a player throws a double he is entitled to 4 moves. For example if he throws a double 3 he is entitled to 4 moves of 3 places each, or 3 moves, 2 of 3 places each and one of 6 places, or 2 moves of 6 places each, or one move of 12 places. Therefore M may have a value of 2 or 4.

When M=4 it is convenient to create 2 additional imaginary die results, D(3) and D(4), rather than to reuse D(1) and D(2).

The playing loop looks like this:

```
480 REM PLAYING LOOP
485 D(1)=INT (RND*6+1)
490 D(2)=INT (RND*6+1)
500 PRINT "THE DIE RESULTS ARE "D(1)" AND"
       D(2) "."
510 IF D(1)<>D(2) THEN 570
520 D(3)=D(4)=D(1)
530 M=4
560 GO TO 600
570 M=2
600 IF F$="WHITE" THEN 630
610 GOSUB 1000         '1000 BEGINS RED'S PLAY
620 GO TO 700
630  GOSUB 4000         '4000 BERGINS WHITE'S
       PLAY
640 REM LINES 700-770 DETERMINE IF THE GAME
       IS OVER AND WHO WON
900 GO TO 480
```

This is the heart of the program and is executed more often than any other part.

You will notice that as written above it is an infinite loop. There are two ways of exiting this loop: If the game is won by either player, the portion of the program between lines 700 and 770 executes a STOP. When it is his turn, White has the option of stopping play by INPUTing "100,100 (RETURN)".

Strategy

By far the greatest challenge of this project has been the construction of a playing strategy for Red. Red's strategy is the longest subroutine of the program, so I will only outline one small part of it. However this part illustrates how effectively the creation of P, C$, and M solves the problem of computerizing backgammon.

In general the most preferable way to take an opponent's man and send him to the bar is to do so with 2 men. Furthermore it is desirable that such a pair of moves not result in opening any of the mover's men; by this I mean leaving one of his men alone on some position where *he* may be taken and sent to the bar when it is the opponent's turn.

Suppose it is Red's turn and the board positions are as pictured in diagram # 4. Red throws a 2 and a 4. What is the ideal pair of moves?

The ideal moves are as follows:

Move the red man on position 10 to position 8, taking the vulnerable white man and sending him to the bar. However Red now has a single man on position 8 which is threatened by the 3 white men on position 7. It is wise for Red to cover that man by using his second die result to move a man from position 12 to position 8.

Red's strategy can reach these decisions in the following way:

A preliminary part of the strategy searches for a position containing a vulnerable white man.

```
8270 FOR X=1 TO 24
8280  IF  C$(X)<> "WHITE"  THEN  3290      '3290
      CONTAINS A "NEXT X"
9006 IF P(X) > 1 THEN 3290
9008 REM IF CONTROL ARRIVES AT THIS LINE A
      VULNERABLE WHITE MAN
9009 REM HAS BEEN FOUND.
```

Strategy must now determine if the following conditions hold: Are the two positions, X+D(1) and X+D(2) occupied by Red? Are these positions occupied by exactly 1, or 3 or more red men? If one of these positions is occupied by exactly 2 red men, moving one of them will open the other.

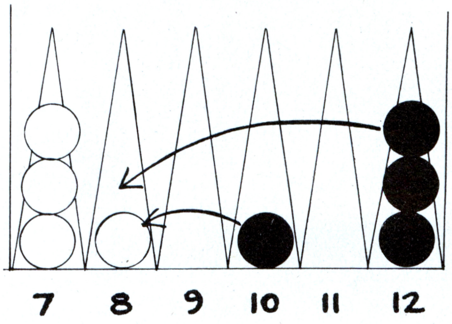
Strategy makes the determination as follows:

```
9024 IF C$(X+D(1) )<> "RED" THEN 9050
9026 IF C$(X+D(2) )<> "RED" THEN 9050
9028 IF P(X+D(1) )=2 THEN 9050
9030 IF P(X+D(2) )= 2 THEN 9050
9031  REM  IF  CONTROL  ARRIVES  HERE  THE
       VULNERABLE WHITE MAN ON
9032 REM POSITION X CAN BE TAKEN ADVAN-
      TAGEOUSLY.
9033 I(1)=X+D(1) ' WHEN STRATEGY GENERATES
      2 MOVES I&J ARE SUBSCRIPTED.
9034 J(1)=D(1)
9036 I(2)=X+D(2)
9038 J(2)=D(2)
9042 GO TO 9534 ' THE PART OF THE PROGRAM
      THAT MAKES RED'S MOVES
9050 REM THE NEXT PART OF STRATEGY
```

Other features of the program

Through BASIC's data file capacity the program writes a running record of the game into a random access numeric file called GMRCn where n is an integer in the range 1-10. This permits a total of 10 different partial games to be recorded. A player may interrupt a game any time it is his turn and request that it be continued at a later time. When he runs the program again later he identifies himself. The program matches his name to the correct GMRC file, accesses the file, and reconstructs the game up to the last throw of the dice. It then prints whose turn it is and transfers control to the appropriate part of the playing loop. When the game is finished the program prints the game record at the terminal, SCRATCHes GMRCn, and makes it available to a new player.

DIAGRAM #4



The player can request a print-out of the current board positions anytime it is his turn. When he does so he gets a terminal display like diagram # 1. This feature permits a restoring of board positions if someone accidently knocks the board over or if White wants to compare the real board to the program's internal board for any other reason.

Summary

These features and all other actions of the program are permitted by three relatively simple devices:

(1) Numbering the board positions 1-24 and creating 4 off-board positions, 2 for bearing off men at the end of a game and 2 for receiving men who have been sent to the bar.

(2) The function P which tells how many men currently occupy a given position.

(3) The string function C$ which tells who currently possesses a given position.

For the future

The program I have described permits a game of backgammon to be played and recorded and is interesting for this reason in its own right.

But the uses to which the program may be put are more tantalizing.

Red's strategy is physically the last subroutine of the program. This facilitates modifications and additions to the strategy or the substitution of a completely new strategy.

The program could be modified so that White becomes another internal player. Then one strategy could be assigned to White and another to Red, terminal print-out could be deleted, and the 2 strategies could be allowed to play against each other. A complete game could be played in this way in a few seconds, permitting an empirical evaluation of the merits of one strategy over another by simply having them play against each other many times and noting the results.

I would welcome correspondence from anyone who has investigated these problems. ■

Another new game from Creative Computing . . . .

BOCCE

Victor I. Bendall

Pub. Note: Several weeks ago I went, with a group of AT&T colleagues, to a small, unpretentious restaurant on East 62 St. in New York by the name of Il Vagabondo. After a huge dinner of veal parmagiana and spaghetti and several carafes of the house vino, we adjourned to the first floor for a game of Bocce. Yes, a grass (mostly dirt) Bocce court right in the mddle of a restaurant right in the middle of uptown Manhattan. Unlikely, but true. We played an 8-ball game (2 teams of 4 members each, 2 rolls per turn in each direction). A stroke of luck for our team when a random shot of mine knocked all of our opponents' balls away from the jack and, on the next roll, one of my partners (at the other end) clinched the game!

Your intake (input?) of Chianti may or may not help your play of Bocce but, in any event, it's a fun game. Now, thanks to Victor Bendall, you can play it on your very own computer or terminal.

We seem to be getting a spate of games in DEC BASIC-PLUS (like this one). Colons (:) separate the multiple statements on one line; inverted saucers are up-arrows and represent exponention. More notes in Victor's comments. —DHA.

```
RUN
BOCCI   02:15 PM        04-Mar-77
THIS GAME SIMULATES THE GAME OF LAWN BOWLS
DO YOU NEED INSTRUCTIONS? ENTER YES OR NO? NO

THE JACK IS LOCATED AT  2319 -95
BALL  1
VELOCITY? 495
ANGLE? 10

JACK AT COORDINATES 2319 -95
BALL 1  AT COORDINATES  2434.05 -63.5199 IT IS 112.278 FROM THE JACK

LONG AND TO THE LEFT

BALL  2
VELOCITY? 480
ANGLE? 9

JACK AT COORDINATES 2319 -95
BALL 1  AT COORDINATES  2434.05 -63.5199 IT IS 112.278 FROM THE JACK
BALL 2  AT COORDINATES  2287.35 -99.7305 IT IS 25.0015 FROM THE JACK

               NICE TRY!  SHORT AND TO THE RIGHT

BALL  3
VELOCITY? 483
ANGLE? 9

JACK AT COORDINATES 2319.08 -95.0328
BALL 1  AT COORDINATES  2434.05 -63.5199 IT IS 112.209 FROM THE JACK
BALL 2  AT COORDINATES  2287.35 -99.7305 IT IS 25.076 FROM THE JACK
BALL 3  AT COORDINATES  2311.99 -92.1334 IT IS .656789 FROM THE JACK

               EXCELLENT SHOT! SHORT AND TO THE LEFT

BALL  4
VELOCITY? 485
ANGLE? 9

JACK AT COORDINATES 2319.08 -95.0328
BALL 1  AT COORDINATES  2434.05 -63.5199 IT IS 112.209 FROM THE JACK
BALL 2  AT COORDINATES  2287.35 -99.7305 IT IS 25.076 FROM THE JACK
BALL 3  AT COORDINATES  2311.99 -92.1334 IT IS .656789 FROM THE JACK
BALL 4  AT COORDINATES  2335.26 -101.796 IT IS 10.5363 FROM THE JACK

               GOOD SHOOTING!  LONG AND TO THE RIGHT


TOTAL DISTANCE OF ALL BALLS FROM THE JACK IS 148.478  CM
FAIR - YOU NEED MORE PRACTICE

CARE TO TRY AGAIN? ENTER YES OR NO? NO


Ready
```

The program simulates the games of Lawn Bowls but is called "Bocce" because the latter game is more recognized in the U.S. and has similar characteristics.

The instructions starting at the line 1770 explains the game. A few points, which may not be obvious, are as follows:

This is the four-ball version (Q=5). Allowing more balls in the game (raising Q) will increase central processing time since the chances of collision will rise and the resulting position of each ball has to be recomputed. However, the delay is short and we routinely play six to eight balls. Increasing Q beyond 9 will require redimensioning the arrays at line 1030.

When there is collision, the bell will sound (line 1500).

It is important to remember that the object is to get close to the jack and not to hit it. Upon collision, the jack will move off more quickly than a ball because it is smaller and lighter. A careless shot can turn a good game into a disaster.

It requires some imagination to play the game well. It goes best if you imagine that you are standing at coordinates 0,0 and are looking out along the X-axis.

I also have a graphic version of this game which plays on a Tektronix 4006-1 terminal. It is easier to play because the trajectory of the thrown ball is plotted as well as the location of all the balls in play. It also allows you to bounce the moving balls off the walls.

If you want the Tektronic 4006-1 version, I suggest you write directly to Victor (we don't have it!) — DHA

Victor I. Bendall is a Professor in the Dept. of Chemistry, Eastern Kentucky University, Richmond, Kentucky 40475.

```
10!********** BOCCI **********
20!
30!***** VICTOR BENDALL *****
40!***** EASTERN KENTUCKY UNIVERSITY *****
50!
1000 Q=5  !TOTAL BALLS IN PLAY INCLUDING JACK. LIMIT OF Q=9
1010 PRINT"THIS GAME SIMULATES THE GAME OF LAWN BOWLS"
1020 INPUT"DO YOU NEED INSTRUCTIONS? ENTER YES OR NO";Z$
1030 DIM B(9),B1(9),D(9),V(9),X(9),Y(9)
1040 PRINT:IF Z$="YES" THEN GOSUB 1770
1050 S1,S2=0: A=-49.3
1060 RANDOMIZE
1070 X(1)=INT(2000+700*RND(0)): Y(1)=INT(200-400*RND(0))
1080 PRINT"THE JACK IS LOCATED AT ";X(1);Y(1)
1090 FOR P=2 TO Q
1100 J=P: GOSUB 1570
1110 NEXT P
1120 FOR J=2 TO Q
1130 D1=D1+D(J)
1140 NEXT J
1150 PRINT:PRINT"TOTAL DISTANCE OF ALL BALLS FROM THE JACK IS";D1;" CM"
1160 IF D1<Q^2 THEN PRINT"MAGNIFICENT BOWLING! WHAT AN EYE!!":GO TO 1230
1170 IF D1<2*Q^2 THEN PRINT"EXCELLENT BUT COULD BE BETTER": GO TO 1230
1180 IF D1<3*Q^2 THEN PRINT"GOOD BUT NEEDS SOME IMPROVEMENT":GO TO 1230
1190 IF D1<6*Q^2 THEN PRINT"FAIR - YOU NEED MORE PRACTICE": GO TO 1230
1200 IF D1<10*Q^2 THEN PRINT"POOR - TRY TO BE MORE CONSISTENT":GO TO 1230
1210 IF D1<20*Q^2 THEN PRINT"YOUR GAME NEEDS LOTS OF WORK":GO TO 1230
1220 PRINT"DON'T PLAY THIS GAME FOR MONEY!!"
1230 FOR J=1 TO Q
1240 B(J),B1(J),D(J),V(J),X(J),Y(J)=0
1250 NEXT J
1260 PRINT:INPUT "CARE TO TRY AGAIN? ENTER YES OR NO"; Y$
1270 PRINT:IF Y$="YES" THEN GO TO 1050 ELSE GO TO 1890
1280 GO TO 1890
1290 IF J=1 THEN K1=0 ELSE K1= -20
1300 A1=A*COS(B(J))+K1*COS((PI/2)+B(J)):A2=A*SIN(B(J))+K1*SIN((PI/2)+B(J))
1310 S3=V(J)*COS(B(J))*0.05+0.00125*A1: S4=V(J)*SIN(B(J))*0.05+0.00125*A2
1320 B(J)=ATN((V(J)*SIN(B(J))+A2*0.05)/(V(J)*COS(B(J))+A1*0.05))
1330 IF B1(J)<0 THEN S4=-S4
1340 S5=S1+S3:   S6=S2+S4
1350 IF J=1 THEN GOTO 1370
1360 IF ABS(S5-X(1))<7 AND ABS(S6-Y(1))<7 THEN LET K=1: GOSUB 1500
1370 FOR K=2 TO Q
1380 IF K=J OR X(K)=0 THEN GOTO 1400
1390 IF ABS(S5-X(K))<10 AND ABS(S6-Y(K))<10 THEN GOSUB 1500
1400 NEXT K
1410 IF V(J)<ABS(A*0.05) THEN GO TO 1440
1420 V(J)=V(J)+(A*0.05):S1=S5:S2=S6:GO TO 1290
1430 GO TO 1290
1440 X(J)=X(J)+S5: Y(J)=Y(J)+S6: S1,S2,S5,S6=0
1450 FOR L=1 TO Q
1460 IF V(L)>ABS(A*0.05) THEN J=L: GO TO 1290
1470 B(L)=0: V(L)=0
1480 NEXT L
1490 GO TO 1630
1500 B(K)=ATN((Y(K)-S2)/(X(K)-S1)): PRINT CHR$(7%);
1510 IF J=1 THEN V(J)=V(J)/5
1520 V(J)=ABS(V(J)*SIN(B(J)-B(K))):V(K)=ABS(V(J)*COS(B(J)-B(K)))
1530 B(J)=((PI/2)+B(K)): S5=S1: S6=S2
1540 IF K=1 THEN V(K)=5*V(K)
1550 IF J=1 THEN V(J)=5*V(J)
1560 RETURN
1570 PRINT "BALL ";(J-1)
1580 INPUT"VELOCITY";V(J): V(J)=ABS(V(J))
1590 IF V(J)>1000 THEN PRINT"VELOCITY TOO HIGH": GO TO 1580
1600 INPUT"ANGLE";B1(J)
1610 IF ABS(B1(J))>89 THEN PRINT"ANGLE TOO BIG": GO TO 1600
1620 PRINT: B(J)=ABS(B1(J)*PI/180):GO TO 1290
1630 PRINT"JACK AT COORDINATES" ;X(1);Y(1)
1640 FOR M=2 TO P
1650 D=(SQR((Y(1)-Y(M))^2+(X(1)-X(M))^2))-7
1660 IF D<0 THEN D(M)=0 ELSE D(M)=D
1670 PRINT"BALL";(M-1);" AT COORDINATES "X(M);Y(M);"IT IS";D(M);
                              "FROM THE JACK"
1680 NEXT M
1690 PRINT
1700 IF D(P)<10 THEN PRINT TAB(15);"EXCELLENT SHOT! ";:GO TO 1740
1710 IF D(P)<20 THEN PRINT TAB(15);"GOOD SHOOTING!  ";:GO TO 1740
1720 IF D(P)<30 THEN PRINT TAB(15);"NICE TRY!  ";:GO TO 1740
1730 IF D(P)>500 THEN PRINT TAB(5);"YECH!! OVER";INT(D(P)/30.48);
                                       "FEET AWAY!  ";
1740 IF X(P)>X(1) THEN PRINT"LONG AND ";ELSE PRINT"SHORT AND ";
1750 IF Y(P)>Y(1) THEN PRINT"TO THE LEFT" ELSE PRINT"TO THE RIGHT"
1760 PRINT:RETURN
1770PRINT"IN THIS GAME YOU ROLL";Q-1;"BALLS SUCCESSIVELY AT A TARGET"
1780PRINT"BALL(CALLED THE JACK).  THE OBJECT IS TO GET THE BALLS AS CLOSE"
1790PRINT"TO THE JACK AS POSSIBLE.  THE BALLS ARE 10 CM IN DIAMETER AND"
1800PRINT"ARE WEIGHTED SO THAT THEY ROLL IN A CURVE.  YOU WILL HAVE TO"
1810PRINT"ROLL THEM AT AN ANGLE TO THE LINE FROM YOU(AT COORDINATES 0,0)"
1820PRINT"TO THE JACK(AT COORDINATES X,Y).  A POSITIVE ANGLE WILL MAKE"
1830PRINT"THE BALL CURVE CLOCKWISE.  A NEGATIVE ANGLE WILL MAKE IT CURVE"
1840PRINT"ANTI-CLOCKWISE.  THE JACK IS 4 CM IN DIAMETER AND WILL ROLL"
1850PRINT"STRAIGHT IF YOU HIT IT.  BALLS HIT BY YOUR THROWN BALL MAY"
1860PRINT"CURVE IN EITHER DIRECTION."
1870 PRINT:PRINT"HINT.  TRY AN INITIAL VELOCITY OF 500 AND AN ANGLE OF 10"
1880 PRINT:PRINT:RETURN
1890 END

Ready
```

Anamorphic Art

Andy A. Zucker

Pub. notes: Andy first sent us his program in BASIC-PLUS (for DEC PDP-11 systems). I wrote back and requested some explanatory notes for those readers not so fortunate to have BASIC-PLUS at their fingertips. Andy responded by not only explaining the BASIC-PLUS goodies he used, but then he translated his program to more-or-less "standard" BASIC. It is this translated program that you now see here. It probably should be noted that a colon (:) separates multiple statements on one line and an exclamation point (!) is equivalent to REMARK but may appear anyplace on a line. Once it appears, nothing else is executed on that line. Due to the use of a DECwriter for output, the exponentiation symbol, normally an up-arrow, looks like a funny umbrella without a shaft (my daughter calls it an upside-down saucer—see Line 580).

Andy also kindly enclosed a piece of reflectized (mirror finish) flexible Mylar, about 8" x 8", which can be rolled into a cylindrical mirror. This, of course, is crucial to correctly viewing cylindrical anamorphic distortions. I found that it's vital to have a smooth, mirror-like viewing surface. Smoothed-out aluminum foil just won't do—too much distortion from the inevitable crinkles. Wish we could have bound in a piece of reflecticized Mylar, but the cost was prohibitive. There currently is a Springbok anamorphic jigsaw puzzle on the market which is quite (very) challenging. It comes with a piece of mylar, although you can certainly find a piece cheaper in a local art-supplies shop or elsewhere. (If you're a puzzle freak like I am, you'll opt for the puzzle, of course.) My applause to Andy for a most original and creative application!—DHA.

Anamorphic (distorted) art has been the subject of a very popular international exhibit recently displayed at the Museum of Fine Arts in Boston. Martin ("Mathematical Games") Gardner wrote on this topic in the January 1975 issue of *Scientific American*. Also, several collections of anamorphic art have recently been published (such as *Hidden Images*, published by H.N. Abrams), and *Natural History* magazine recently had an article on the subject.

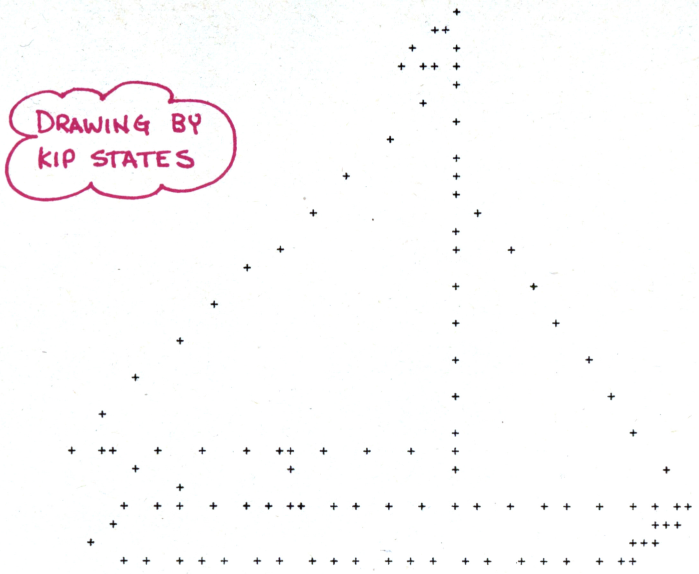
What I've done is to write a computer program which produces a certain, popular kind of anamorphic art—namely cylindrical distortions. These drawings look weird unless they are viewed in a cylindrical mirror placed vertically at the proper location.

To use the program to make a cylindrical anamorphism one begins by drawing a normal picture on a 0-to-60 (x) by 0-to-60 (y) grid, such as 10-square-per-inch graph paper. The picture is entered into the computer as a series of points, lines, circles, or portions of circles. The picture may be output "as is" to check its accuracy. Finally, the "transform" command causes the computer to compute the image of each picture-point, order the image-points for output, and draw the anamorphism.

The results are surprising and amusing. They will interest artists, mathematicians, and anyone who is interested in the "graphics" capility of a simple terminal like a Teletype. Analyzing how the program works would make a good exercise for h.s. math students, as it involves polar coordinates, sines, and cosines.

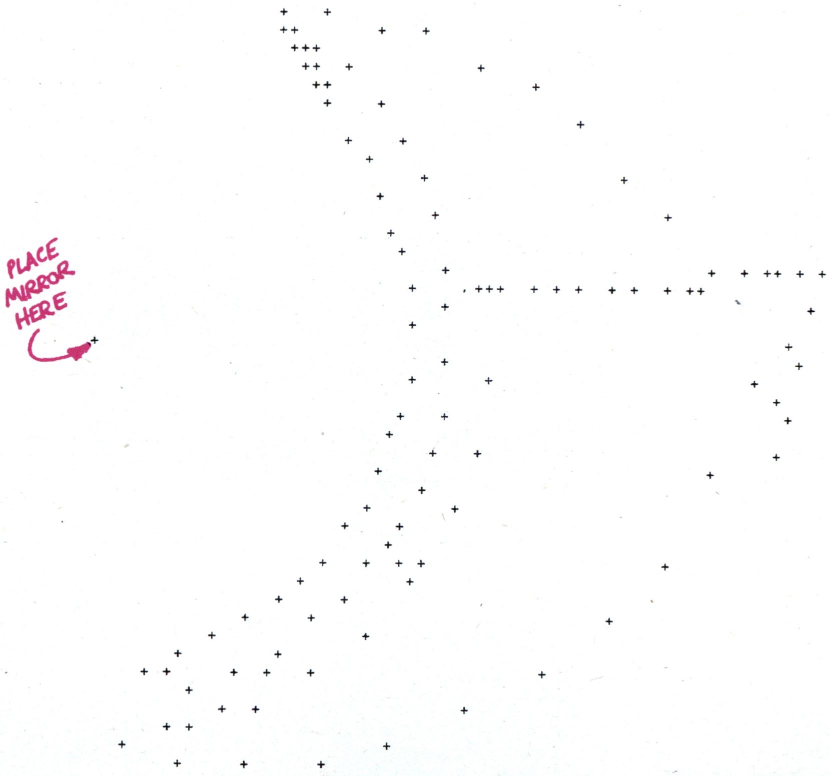
Andy A. Zucker is on the faculty of Milton Academy, 170 Centre Street, Milton, Massachusetts 02186.

```
COMMAND? D
```



DRAWING BY KIP STATES

```
COMMAND? T
```



PLACE MIRROR HERE

```
10      REM     ANAMORPHIC ART PROGRAM

20      REM     BY ANDY ZUCKER, MILTON ACADEMY, DECEMBER 1976
                 (WITH THANKS TO J. PIAZZA)

50      INPUT"INSTRUCTIONS (Y/N)";I$
        : IF I$<>"Y" THEN 200

54 PRINT: PRINT
55 PRINT TAB(4);"THIS PROGRAM WILL:":
 PRINT "A) ENTER A PICTURE FROM THE TERMINAL USING COMMANDS TO CREATE":
 PRINT "POINTS, LINES, CIRCLES, OR PORTIONS OF CIRCLES"
60 PRINT "B)  DRAW THE PICTURE ENTERED"
65 PRINT "C)  DRAW A DISTORTED PICTURE (CALLED AN ANAMORPHISM) WHICH":
 PRINT "LOOKS IDENTICAL TO B) IF IT IS VIEWED IN A 2.5 INCH DIAMETER":
 PRINT "CYLINDRICAL MIRROR (WHICH CAN BE MADE FROM SILVERED MYLAR PAPER)"
70 PRINT
75 PRINT TAB(4);"YOUR PICTURE MAY CONTAIN UP TO 200 POINTS":
 PRINT "THE PROGRAM ASSUMES A SQUARE PICTURE GRID WITH X AND Y":
 PRINT "COORDINATES FROM 0 TO 60 (NEED NOT BE INTEGERS)"
80 PRINT
85 PRINT TAB(4);"VALID COMMANDS ARE:":
 PRINT "P (OR POINTS)";TAB(20);"TO ENTER SOME POINTS":
 PRINT "L (OR LINE)";TAB(20);"TO ENTER A STRAIGHT LINE SEGMENT"
90 PRINT "C (OR CIRCLE)";TAB(20);"TO ENTER ALL OR PART OF A CIRCLE":
 PRINT"D (OR DRAW)";TAB(20);"TO VIEW THE (NORMAL) DRAWING":
 PRINT "T (OR TRANSFORM)";TAB(20);"TO PRODUCE THE ANAMORPHISM"
95 PRINT "E (OR EXIT)";TAB(20);"TO STOP THE PROGRAM":&:&


200     DIM X(201),Y(201)
210     DIM N(120)
310     PRINT "SO FAR";N;"POINTS ENTERED."
320     PRINT: INPUT "COMMAND";C$
325     IF (C$="DRAW" OR C$="D") THEN 2050 ELSE
        IF (C$="TRANSFORM" OR C$="T") THEN 1030
330     IF (C$="POINTS" OR C$="P") THEN 400 ELSE
        IF (C$="LINE" OR C$="L") THEN 450 ELSE
        IF (C$="CIRCLE" OR C$="C") THEN 500 ELSE
        IF (C$="EXIT" OR C$="E") THEN 9999 ELSE GOTO 320

400     INPUT "HOW MANY";P                          !!!   POINTS   !!!
410     INPUT "X,Y";X(I),Y(I) FOR I=N+1 TO N+P
        : N=N+P
420     GOTO 310

450     INPUT "ENDPOINT--X,Y";A(I);B(I) FOR I=1 TO 2 !!! LINES  !!!
460     INPUT"NO. OF POINTS ON THE LINE";P
        : IF P<2 THEN 460
470     S=1/(P-1)
480     FOR I=N+1 TO N+P
                 :X(I)=(I-N-1)*S*[A(2)-A(1)]+A(1)
                 :Y(I)=(I-N-1)*S*[B(2)-B(1)]+B(1)
490     NEXT I: N=N+P: GOTO 310

500     INPUT "COORDINATES OF CENTER";A(1);B(1)      !!! CIRCLES !!!
```

```
505     INPUT "NO. OF POINTS ON THE ARC";P
510     INPUT "ENTIRE CIRCLE (E) OR PORTION ONLY (P)";X$
        : IF X$="E" THEN INPUT "RADIUS";R ELSE GOTO 550
520     S=2*PI/P : T=0
530     FOR I=N+1 TO N+P
                :X(I)=R*COS[T +(I-N-1)*S] +A(1)
                :Y(I)=R*SIN[T +(I-N-1)*S] +B(1)
540     NEXT I: N=N+P: GOTO 310

550     PRINT "COORDINATES OF ARC START-POINT"          ! CIRCLES (CONT) !
555     INPUT "GOING COUNTER-CLOCKWISE";A(2);B(2)
560     INPUT "FRACTION OF CIRCLE (LESS THAN 1)";F
        : IF F>=1 THEN 560
570     IF A(2)-A(1)=0 THEN 575
572             T=ATN [ (B(2)-B(1))/(A(2)-A(1))]
                : IF A(2)<A(1) THEN T=T+PI
573             GOTO 580
575             T=PI/2 : IF B(2)<B(1) THEN T=-T
580     S=2*PI*F/(P-1) : R=SQR [(B(2)-B(1))^2 +(A(2)-A(1))^2 ]
        : GOTO 530


1000    REM THIS SECTION TRANSFORMS EACH POINT TO ITS IMAGE IN THE
                ANAMORPHISM
1030    LET K=.45 : L=-1.5       ! THETA =KX+L (THETA IN RADIANS)
1040    LET A=.75 : B=2.5        ! RADIUS = AY+B (RADIUS IN INCHES)
                                 ! (CONSTANTS DETERMINED EMPIRICALLY)
1050    FOR I=1 TO N     ! TRANSFORM EACH POINT
1060            X=.1*X(I) : Y=.1*Y(I)   ! X, Y IN INCHES
1070            T=K*X+L  : R=A*Y+B
1080            X(I)=10*R*COS(T)
                : Y(I)=10*R*SIN(T)       ! NOW X,Y IN TENTHS OF INCHES AGAIN
1090    NEXT I


2000    REM     THIS SECTION ORDERS THE POINTS IN THE ARRAY FOR DISPLAY
2010    N=N+1: X(N),Y(N)=0    ! SHOW THE ORIGIN IN AN ANAMORPHISM
2050    N(I)=0 FOR I=0 TO 120
2060    FOR A=1 TO N     !!!    SORT BY Y-COORDINATE !!!
2070            F=0
                : FOR B=1 TO N-A
2080                    IF Y(B)>=Y(B+1) THEN 2110
2090                    F=1
                        :T=Y(B) : T2=X(B)
2100                    Y(B)=Y(B+1) :X(B)=X(B+1)
                        :Y(B+1)=T : X(B+1)=T2
2110            NEXT B
2120            IF F=0 THEN 2140
2130    NEXT A

2140    R=1:N2=0: L=FNR(Y(1))
2150    FOR I=1 TO N                 !. HOW MANY POINTS IN EACH ROW??
2160            IF FNR(Y(I))=L THEN N2=N2+1: GOTO 2190
2170            N(R)=N2
                : N2=1 : R=R+1
2180            L=FNR(Y(I))
```

```
2190    NEXT I
2200    N(R)=N2

2210    N(I)=N(I)+N(I-1) FOR I=1 TO R    ! MAKE N() CUMULATIVE
2220    FOR I=1 TO R            ! FOR EACH ROW OF OUTPUT, SORT BY X-COORD.
2230            FOR A=1 TO N(I)-N(I-1): F=0
2240                    FOR B=N(I-1)+1 TO N(I)-A
2250                            IF X(B)<=X(B+1) THEN 2280
2260                            F=1
                                :T=Y(B) : T2=X(B)
2270                            Y(B)=Y(B+1) : X(B)=X(B+1)
                                : Y(B+1)=T : X(B+1)=T2
2280                    NEXT B
2290                    IF F=0 THEN 2310
2300            NEXT A
2310    NEXT I

3000    REM     THIS SECTION DRAWS THE PICTURE(S)
3010    C2$="+"         ! C2$ IS THE CHARACTER TO DRAW WITH
3020    S=0
3030    L=FNR(Y(1))
3040    FOR I=1 TO N                    ! FOR EVERY POINT IN THE ORDERED FILE
3050            IF FNR(Y(I))<>L THEN
                        PRINT FOR J=1 TO L-FNR(Y(I))
                        : L=FNR(Y(I)) : S=0
3060            IF S>INT(X(I)+.5) THEN 3070
3065            PRINT TAB [INT(X(I)+.5)];C2$;
                : S= INT(X(I)+.5)+1   ! S GIVES POSITION OF PRINT HEAD
3070    NEXT I
3080    PRINT: IF (C$="DRAW" OR C$="D") THEN 320


3090    DEF FNR(Y)=INT( .6*Y+.5 )
                !  FUNCTION ADJUSTS FOR HORIZONTAL SPACING
                   AND ROUNDS OFF TO THE NEAREST LINE


9999    END
```

```
Ready

RUN ANAMOR
INSTRUCTIONS (Y/N)? Y


    THIS PROGRAM WILL:
A) ENTER A PICTURE FROM THE TERMINAL USING COMMANDS TO CREATE
POINTS, LINES, CIRCLES, OR PORTIONS OF CIRCLES
B)  DRAW THE PICTURE ENTERED
C)  DRAW A DISTORTED PICTURE (CALLED AN ANAMORPHISM) WHICH
LOOKS IDENTICAL TO B) IF IT IS VIEWED IN A 2.5 INCH DIAMETER
CYLINDRICAL MIRROR (WHICH CAN BE MADE FROM SILVERED MYLAR PAPER)

    YOUR PICTURE MAY CONTAIN UP TO 200 POINTS
THE PROGRAM ASSUMES A SQUARE PICTURE GRID WITH X AND Y
COORDINATES FROM 0 TO 60 (NEED NOT BE INTEGERS)

    VALID COMMANDS ARE:
P (OR POINTS)       TO ENTER SOME POINTS
L (OR LINE)         TO ENTER A STRAIGHT LINE SEGMENT
C (OR CIRCLE)       TO ENTER ALL OR PART OF A CIRCLE
D (OR DRAW)         TO VIEW THE (NORMAL) DRAWING
T (OR TRANSFORM)    TO PRODUCE THE ANAMORPHISM
E (OR EXIT)         TO STOP THE PROGRAM


SO FAR 0 POINTS ENTERED.

COMMAND? CIRCLE
COORDINATES OF CENTER? 30,30
NO. OF POINTS ON THE ARC? 40
ENTIRE CIRCLE (E) OR PORTION ONLY (P)? E
RADIUS? 30
SO FAR 40 POINTS ENTERED.

COMMAND? LINE
ENDPOINT--X,Y? 30,60
ENDPOINT--X,Y? 12.5,6
NO. OF POINTS ON THE LINE? 15
SO FAR 55 POINTS ENTERED.

COMMAND? LINE
ENDPOINT--X,Y? 30,60
ENDPOINT--X,Y? 47.5,6
NO. OF POINTS ON THE LINE? 15
SO FAR 70 POINTS ENTERED.

COMMAND? LINE
ENDPOINT--X,Y? 12.5,6
ENDPOINT--X,Y? 58.5,39.5
NO. OF POINTS ON THE LINE? 15
SO FAR 85 POINTS ENTERED.

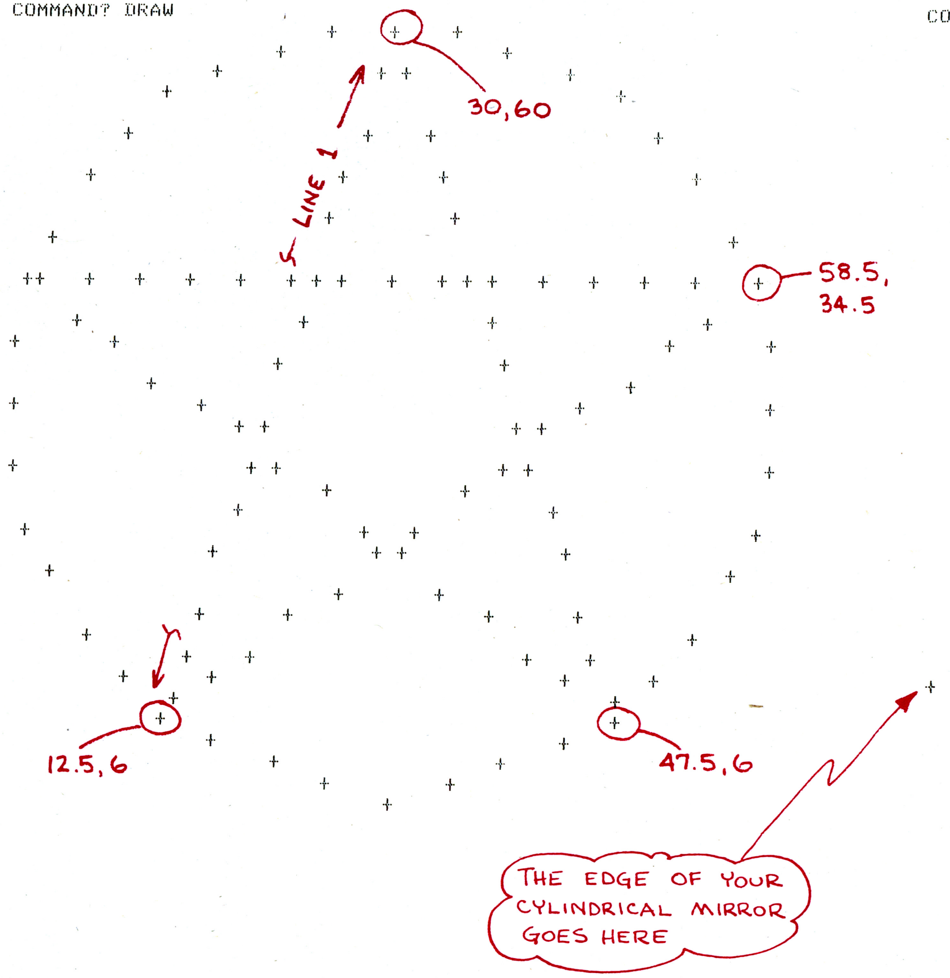
COMMAND? LINE
ENDPOINT--X,Y? 47.5,6
ENDPOINT--X,Y? 1.5,39.5
NO. OF POINTS ON THE LINE? 15
SO FAR 100 POINTS ENTERED.

COMMAND? LINE
ENDPOINT--X,Y? 1.5,39.5
ENDPOINT--X,Y? 58.5,39.5
NO. OF POINTS ON THE LINE? 15
SO FAR 115 POINTS ENTERED.
```

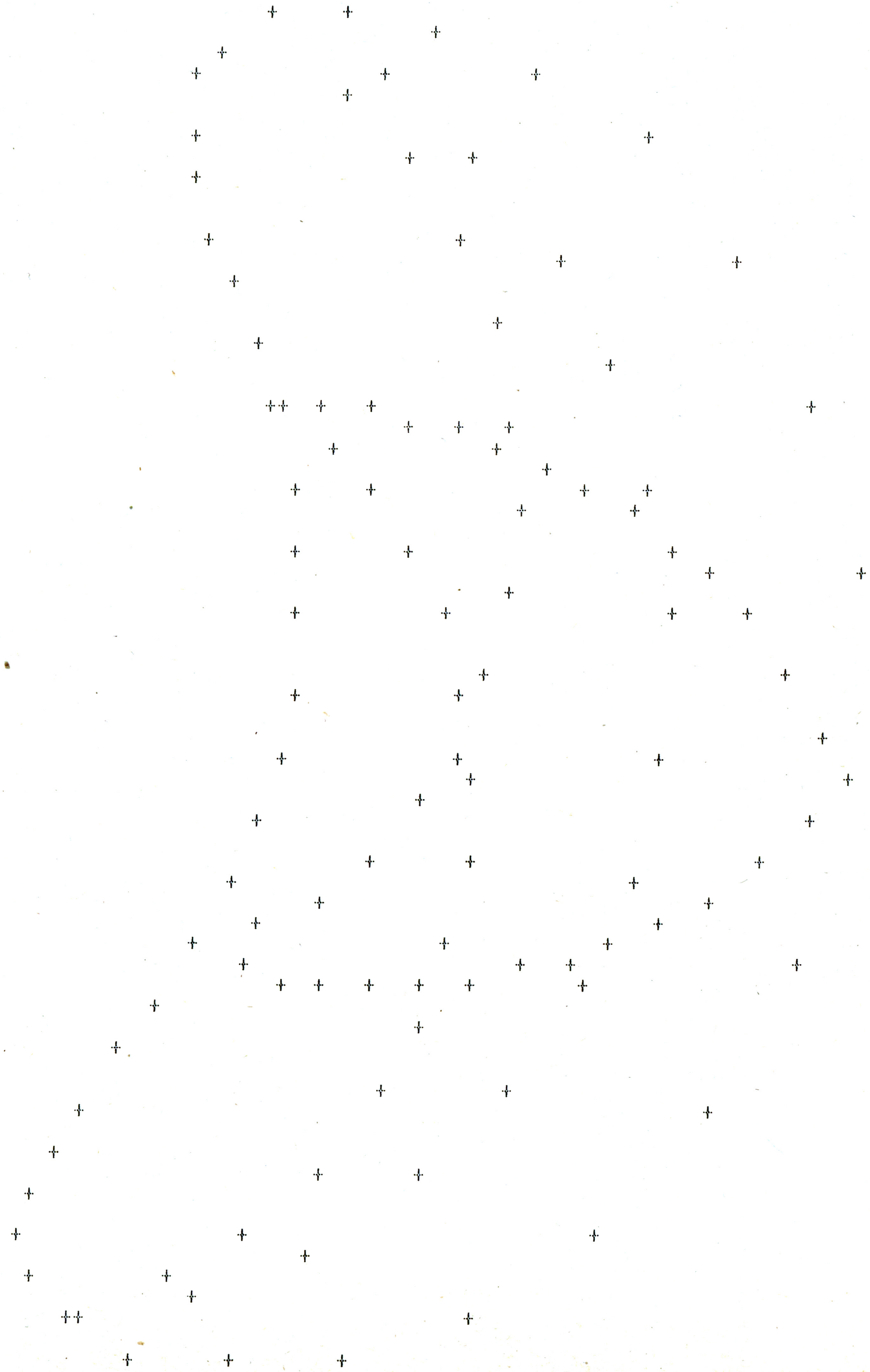
THIS DRAWS LINE 1

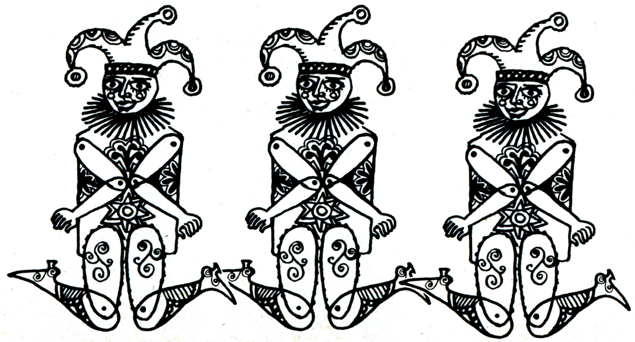
TO DRAW A STAR YOU HAVE TO FIGURE OUT THE COORDINATES OF THE FIVE POINTS. IT HELPS TO DRAW YOUR PICTURE FIRST ON QUADRILLE OR SQUARE GRAPH PAPER.

```
COMMAND? DRAW
```


30,60
LINE 1
58.5, 34.5
12.5,6
47.5,6
THE EDGE OF YOUR CYLINDRICAL MIRROR GOES HERE

```
COMMAND? TRANSFORM
```





Another new game from Creative Computing . . . .

UFO

by Raymond J. Kernay

Tired of the many trek games already done, and done well, I decided to invent my own space game, with my own rules. The result was UFO. It differs from the Star Trek games I have seen in its general format and weapon selection. The same idea prevails, however: kill or be killed.

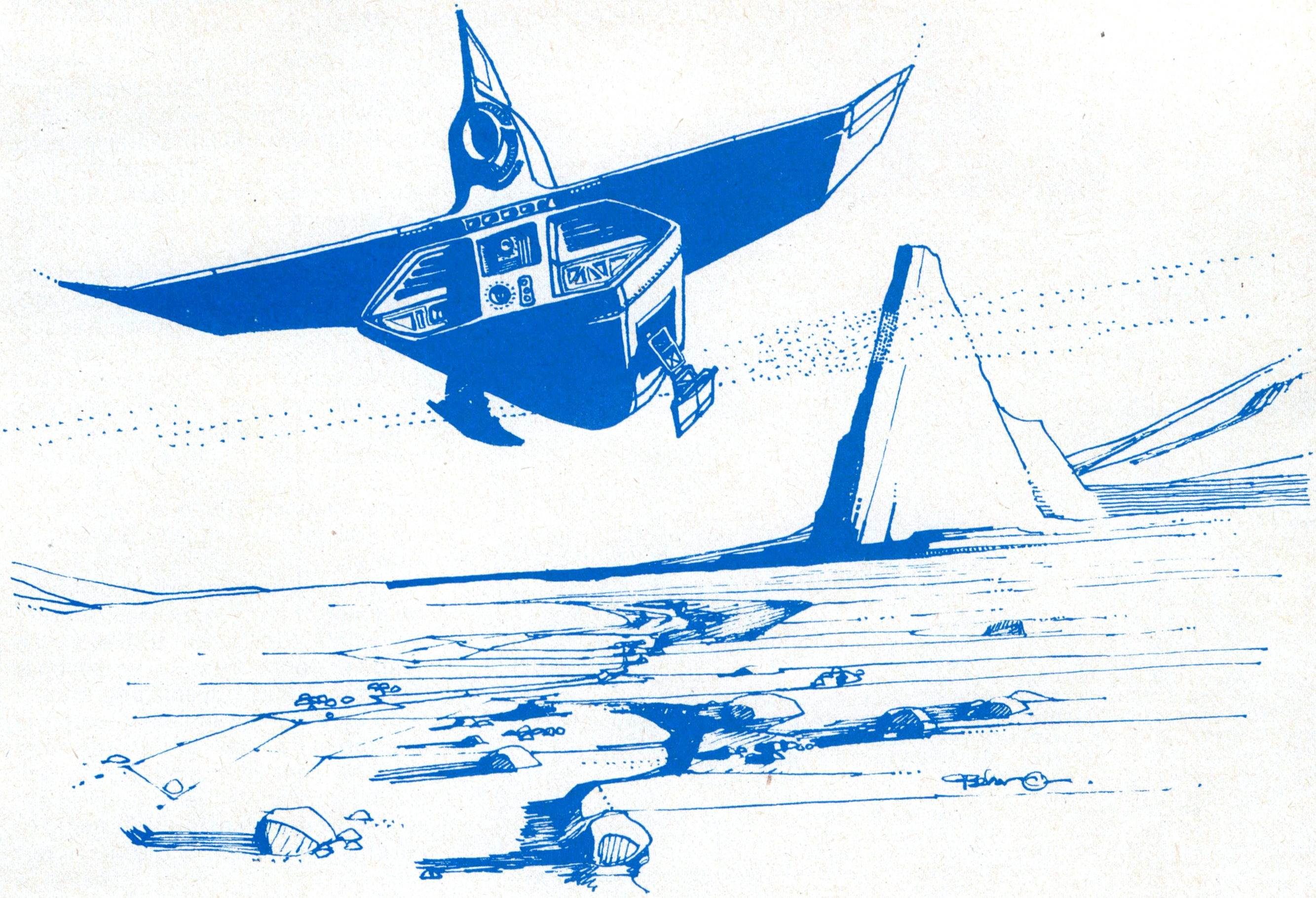
UFO is a strategy game in which you play against the computer in a life-and-death struggle for superiority of space. It takes place after a space war with another planet in which both earth and the attacker's planet are destroyed. Both planets—basically similar in strength, social structure, and scientific awareness—realizing they are doomed, launch a "lifeboat" into space. The lifeboats are equally armed and powered.

However, the aliens are much better marksmen, hitting once out of every two shots (in lines 880-890, the computer's odds are set). The reason is as follows. The enemy ship's decision is made by the program; the enemy will only retreat if he feels you are ramming and will approach only if you are running and/or his fuel is running out (smaller weaponry eats up less fuel). He will only use option 6 (no move but gains fuel) if his energy is below a certain point. In other words, you can think, while he cannot. You have the advantage of your mind, so the alien has been given the advantage of a good steady aim.

The game is set in the future: civilization is destroyed, 150 people are left, and you are in command. The enemy has never truly been seen, as many enemies are never truly seen, but nevertheless you must destroy him or be destroyed. Your weapons are explained and the game begins. In your command ship is a control which will not allow you to make an illegal move. This control waits after you fire for the shot to reach the other ship and for the explosion reports to reach the ship. It then gives a full report of power drain of both ships. If your power is not negative you are still in the game but once it drops below zero your crew dies (the energy level is the amount of energy left to counteract the attack. If more energy hits the ship than was repulsed, the ship is destroyed. If the amounts are equal then the ship had exactly the same amount of energy as the attack drained.) If in any game you can get close enough to your enemy to use your heavy guns without frightening off the enemy (5000-11000), the game will last for quite a long time. Theoretically this game will last forever if played logically.

Raymond J. Kerney, 712 Crawford Ave., Brooklyn, NY 11223.

```
 10 PRINT
 20 PRINT
 30 PRINT
 40 PRINT
 50 PRINT
 60 DIM P(1)
 70 RANDOMIZE
 80 REM U.F.O.
 90 PRINT " DO YOU WANT INSTRUCTIONS";
100 INPUT A$\IF A$="NO" THEN 480\IF A$="YES" THEN 110\GO TO 90
110 PRINT " YOU ARE ABOUT TO RECIEVE HIGH SECURITY INFORMATION"
120 PRINT " PLEASE EAT THE COMPUTOR READ OUT AFTER READING"
130 PRINT\PRINT\PRINT
140 PRINT " THIS IS THE YEAR 2080...CIVILIZATION AS YOU KNOW IT HAS"
150 PRINT " BEEN DESTROYED...NATIONS HAVE BEEN REDUCED TO RUBBLE"
160 PRINT " IN A MASSIVE SPACE WAR"
170 PRINT " YOU ARE ONBOARD A SPACE SHIP WHOSE SOLE PURPOSE"
180 PRINT " IS TO SAFE GUARD THE 150 PEOPLE ON YOUR SHIP...THE "
190 PRINT " SOLE SURVIVORS...YOUR MISSION: FIND A PLANET SUITABLE"
200 PRINT " FOR YOUR COLONISTS.....PROBLEM: THE ENEMY OF EARTH STILL"
210 PRINT " EXISTS. STRANGE CREATURES NEVER SEEN BY MAN"
220 PRINT \PRINT " BY THE TIME YOU READ THIS EARTH WILL NO "
230 PRINT " LONGER EXIST.....HERE ARE YOUR VITAL DATUM:"
240 PRINT TAB(10);"YOU ARE EQUIPTED WITH 10000 UNITS OF ENERGY"
250 PRINT TAB(10);"WHEN YOU RUN OUT THE ALIENS WILL DESTROY YOU"
260 PRINT\PRINT\PRINT\PRINT TAB(25);"WEAPONTRY"
270 PRINT "TYPE";  TAB(5);"DESCRIPTION";TAB(17);"CAPACITY";TAB(26);"FUEL
DRAIN"
280 PRINT "  1";TAB(5);"HEAVY GUNS";TAB(17);"0-11000";TAB(27);"10 UNITS"
290 PRINT "  2";TAB(5);"WARHEADS";TAB(14);"10000-100000";TAB(27);"100 UN
ITS"
300 PRINT "  3";TAB(5);"LAZER";TAB(13);"100000-200000";TAB(27);"1000 UNI
TS"
310 PRINT \PRINT\PRINT TAB(25);" OPTIONS"
320 PRINT"  4";TAB(5);"APPROACH";TAB(17);"---------";TAB(26);"100 UNITS"
330 PRINT "  5";TAB(5);"RETREAT";TAB(17);"---------";TAB(26);"100 UNITS"
340 PRINT"  6";TAB(5);"BY TYPING 6 YOU CAN PASS AND GAIN 100 UNITS"
350 PRINT TAB(5);"(LABORERS WORK TO PRODUCE POWER)"
360PRINT \PRINT\PRINT TAB(25);"ENEMY"
370 PRINT \PRINT" THE ENEMY HAS SAME CAPABILITIES THAT YOU HAVE"
380 PRINT " EACH TIME A SHIP IS HIT ITS ENERGY DRAIN IS EQUAL TO"
390 PRINT " THE AMOUNT OF ENERGY SPENT*10(EXCEPT LAZARWHICH EQUALS"
400 PRINT TAB(35); " THE AMOUNT SPENT*3 UNITS"
410 PRINT " BOTH SHIPS ARE ON THE SAME MISSION,DESTINATION AND BOTH"
420 PRINT " ARE ON EQUAL TERMS"
430 PRINT " UNFORTUNATELY YOU MUST KILL EACH OTHER TO WIN"
440 PRINT " YOUR MAXIMUM SPEED IS A JUMP OF 50000 MILES, HOWEVER,"
450 PRINT " SPEEDS VARY BETWEEN 10000-50000"
460 PRINT " WARHEADS TRAVEL AT 35000 PER SEC...SHELLS 1000 PER SEC"
470 PRINT " THIS MESSAGE WAS RECORDED EARTH IS DEAD...GOD'S LUCK"
480 PRINT \PRINT\PRINT\PRINT"THIS IS COMPUTOR CONTROL WHAT IS YOUR NAME";
490 LINPUT A$,B$,C$\PRINT "VERY GOOD ";A$;B$;C$
500 P=10000\P(1)=10000\A=RND(1)*200000
510 PRINT "LEAVING PLANETARY ORBIT ";A$;B$;C$;" SHIP APPROCHING AT";A;"M
ILES"
520 PRINT " WHAT ARE YOUR ORDERS ";A$;B$;C$;\INPUT C
530 O=INT(RND(1)*2)+1
540 IF C=1 THEN 570\IF C=2 THEN 650\IF C=3 THEN 710\IF C=4 THEN 750
550 IF C=5 THEN 780\IF C=6 THEN 820
560 PRINT " ";A$;B$;C$;" LETS NOT CRACK UNDER PRESURE"\GO TO 520
570 IF A>11005 THEN 560
580 P=P-10\PRINT " GUNS FIRED"
590 FOR X=1 TO A*2 STEP 1000
600 SLEEP 1\NEXT X
610 IF O=1 THEN 630
620 PRINT " MISSED TOO BAD"\GO TO 830
630 PRINT " DIRECT HIT.......ENEMY SHIP'S POWER DOWN"
640 P(1)=P(1)-100\GO TO 830
650 IF A>100000 THEN 560\IF A <10000 THEN 560
660 P=P-100\PRINT " WARHEAD LAUNCHED"\FOR X=1 TO A*2 STEP 35000
670 SLEEP 1\NEXT   X
680 IF O=1 THEN 690\PRINT "MISSED TOO BAD"\GO TO 830
690 PRINT " DIRECT HIT.....ENEMY SHIP'S POWER DOWN"
700 P(1)=P(1)-1000\GO TO 830
710IF A <100000 THEN 560\P=P-1000\PRINT " LAZAR FIRED"\SLEEP 3
720 IF O=1 THEN 730\PRINT "MISSED TOO BAD"\GO TO 830
730 PRINT " DIRECT HIT.....ENEMY SHIP'S POWER DOWN"
```



```
740 P(1)=P(1)-3000\GO TO 830
750 B=RND(1)*40000+10000\A=A-B\P=P-100\IF A<1 THEN770
760 GO TO 830
770 PRINT "***COLLISION***"\PRINT " BOTH SHIPS DESTROYED"\GO TO 1080
780 B=RND(1)*40000+10000\A=A+B\P=P-100\IF A>200050 THEN 800
790 GO TO 830
800 PRINT A$;" YOUR RANGE IS ";A;" BUT WE CANNOT RUN,RANGE IS NOW 200000"
810 A=200000\GO TO 830
820 P=P+100
830 PRINT " ENEMY SHIP REPORT"\PRINT " RANGE=";A;"POWER=";P(1)
840 IF P(1)<1 THEN 1110
850 IF P(1)<500 THEN 1040
860 IF A<5000 THEN 1070
870 R=INT(RND(1)*3)+1\O=INT(RND(1)*2)+1
880 IF R=1 THEN 970\IF R=2 THEN 920
890 IF A<100000 THEN 870\P(1) =P(1)-1000\PRINT " ENEMY FIRES LAZAR"
900 IF O=1 THEN 910\PRINT " MISSED...WHEW!"\GO TO 1010
910 PRINT " DIRECT HIT..... POWER DOWN"\P=P-3000\GO TO 1010
920 IF A>100000 THEN 870\IF A<10000 THEN 870
930 P(1)=P(1)-100\PRINT " ENEMY WARHEAD FIRED "
940 FOR D=1 TO A STEP 35000\SLEEP 1\NEXT D
950 IF O=1 THEN 960\PRINT " MISSED... WHEW!"\GO TO 1010
960 P=P-1000\PRINT " DIRECT HIT!..POWER DOWN"\GO TO 1010
970 IF A>11000 THEN 870\P(1)=P(1)-10\PRINT " ENEMY FIRES SHELL"
980 FOR D=1 TO A STEP 1000\SLEEP 1\NEXT D
990 IF O =1 THEN 1000\PRINT " MISSED...WHEW"\GO  TO 1010
1000 PRINT " DIRECT HIT .....POWER DOWN"\P=P-100
1010 PRINT\PRINT\PRINT TAB(10); " STATUS OF SHIP"
1020 PRINT" RANGE=";A;"POWER SUPPLY=";P\IF P<1 THEN 1130
1030 GO TO 520
1040 P(1)=P(1)+100\PRINT " ENEMY SHIP RESTING"\GO TO 1010
1050 B=RND(1)*40000+10000\A=A-B\PRINT " ENEMY SHIP APPROCHING ";A$;B$;C$
1060 GO TO 1010
1070 B=RND(1)*40000+10000\A=A+B\PRINT "ENEMY SHIP RETREATING"\GO TO 1010
1080 PRINT " THAT WAS A PRETTY  DUMB THING TO DO ";A$;B$;C$
1090 PRINT " YOUR MISSION IS TO PROTECT YOUR PASSENGERS NOT DESTROY"
1100 GO TO 1140
1110 PRINT " ENEMY SHIPS POWER GONE NO LIFE PRESENT"
1120 PRINT " MISSION SUCESSFUL"\GO TO 1210
1130 PRINT " ENEMY IS VICTOR LIFE SUPPORT FADING CREW DYING"
1140 SLEEP 10
1150 PRINT
1160 PRINT
1170 PRINT
1180 PRINT " PLAY AGAIN";
1190 INPUT A$
1200 IF A$="YES" THEN 10
1210 END
```

```
DO YOU WANT INSTRUCTIONS? YES
YOU ARE ABOUT TO RECIEVE HIGH SECURITY INFORMATION
PLEASE EAT THE COMPUTOR READ OUT AFTER READING

THIS IS THE YEAR 2080...CIVILIZATION AS YOU KNOW IT HAS
BEEN DESTROYED...NATIONS HAVE BEEN REDUCED TO RUBBLE
IN A MASSIVE SPACE WAR
YOU ARE ONBOARD A SPACE SHIP WHOSE SOLE PURPOSE
IS TO SAFE GUARD THE 150 PEOPLE ON YOUR SHIP...THE
SOLE SURVIVORS...YOUR MISSION: FIND A PLANET SUITABLE
FOR YOUR COLONISTS.....PROBLEM: THE ENEMY OF EARTH STILL
EXISTS. STRANGE CREATURES NEVER SEEN BY MAN

BY THE TIME YOU READ THIS EARTH WILL NO
LONGER EXIST.....HERE ARE YOUR VITAL DATUM:
          YOU ARE EQUIPTED WITH 10000 UNITS OF ENERGY
          WHEN YOU RUN OUT THE ALIENS WILL DESTROY YOU



                              WEAPONTRY
TYPE DESCRIPTION CAPACITY FUEL DRAIN
  1  HEAVY GUNS  0-11000   10 UNITS
  2  WARHEADS 10000-100000 100 UNITS
  3  LAZER   100000-200000 1000 UNITS


                              OPTIONS
  4  APPROACH      ---------100 UNITS
  5  RETREAT       ---------100 UNITS
  6  BY TYPING 6 YOU CAN PASS AND GAIN 100 UNITS
     (LABORERS WORK TO PRODUCE POWER)


                              ENEMY

THE ENEMY HAS SAME CAPABILITIES THAT YOU HAVE
EACH TIME A SHIP IS HIT ITS ENERGY DRAIN IS EQUAL TO
THE AMOUNT OF ENERGY SPENT*10(EXCEPT LAZARWHICH EQUALS
                                          THE AMOUNT SPENT*3 UNITS
BOTH SHIPS ARE ON THE SAME MISSION, DESTINATION AND BOTH
ARE ON EQUAL TERMS
UNFORTUNATELY YOU MUST KILL EACH OTHER TO WIN
YOUR MAXIMUM SPEED IS A JUMP OF 50000 MILES, HOWEVER,
SPEEDS VARY BETWEEN 10000-50000
WARHEADS TRAVEL AT 35000 PER SEC...SHELLS 1000 PER SEC
THIS MESSAGE WAS RECORDED EARTH IS DEAD...GOD'S LUCK



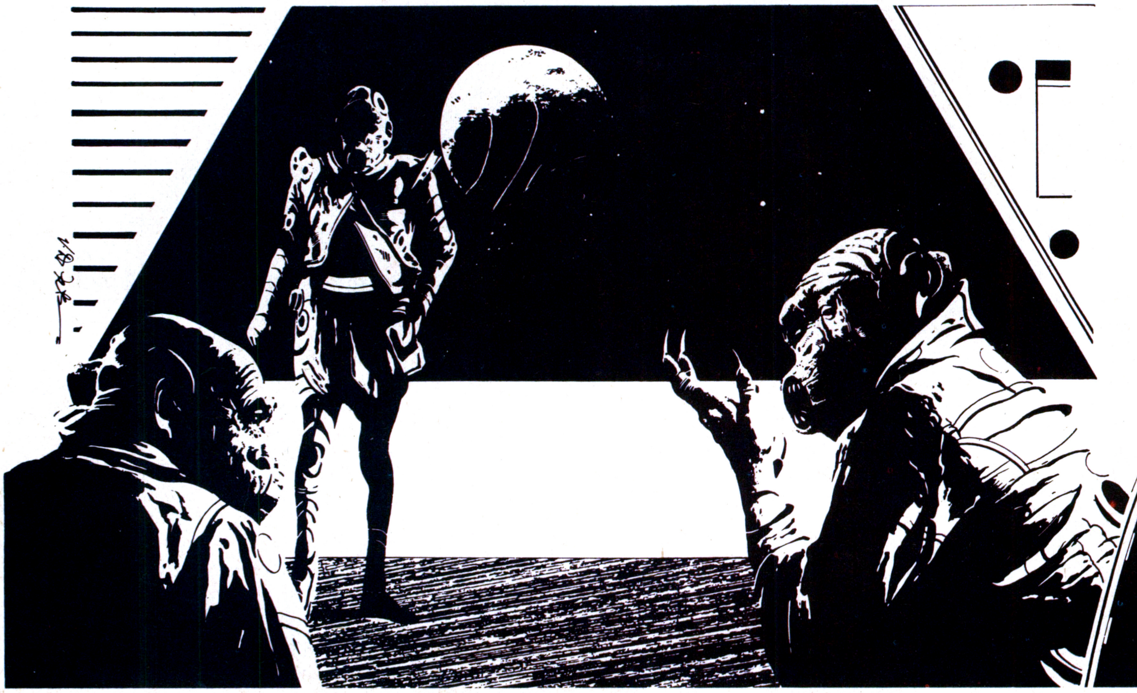
THIS IS COMPUTOR CONTROL WHAT IS YOUR NAME? JOHN
VERY GOOD JOHN
LEAVING PLANETARY ORBIT JOHN SHIP APPROCHING AT 183008.7 MILES
 WHAT ARE YOUR ORDERS JOHN? 4
 ENEMY SHIP REPORT
 RANGE= 151953.7 POWER= 10000
 ENEMY FIRES LAZAR
 DIRECT HIT..... POWER DOWN
```

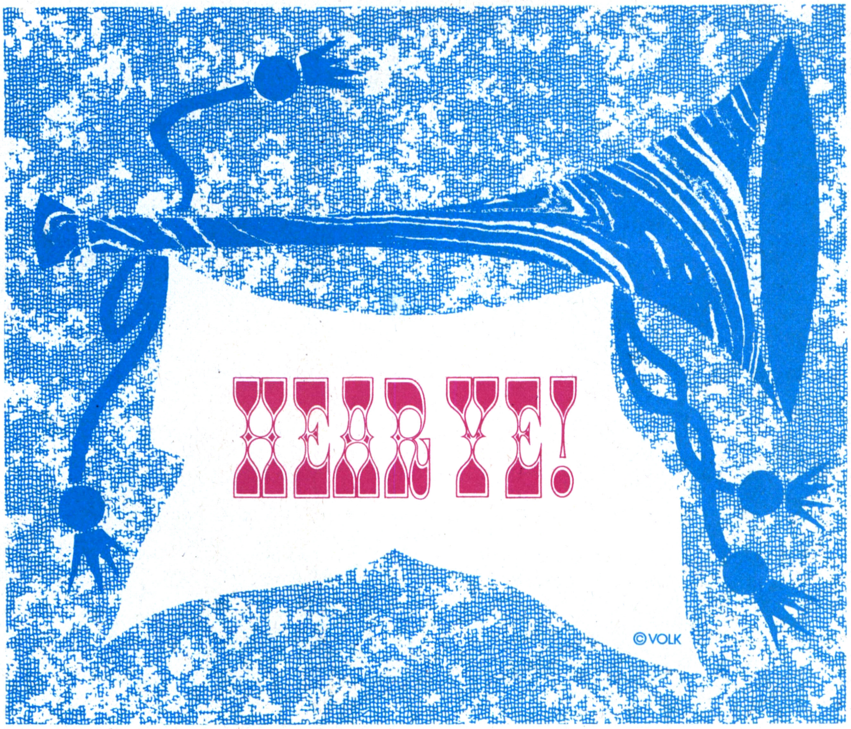
```
          STATUS OF SHIP
 RANGE= 151953.7 POWER SUPPLY= 6900
 WHAT ARE YOUR ORDERS JOHN? 3
 LAZAR FIRED
MISSED TOO BAD
 ENEMY SHIP REPORT
 RANGE= 151953.7 POWER= 9000
 ENEMY FIRES LAZAR
 MISSED...WHEW!


          STATUS OF SHIP
 RANGE= 151953.7 POWER SUPPLY= 5900
 WHAT ARE YOUR ORDERS JOHN? 3
 LAZAR FIRED
MISSED TOO BAD
 ENEMY SHIP REPORT
 RANGE= 151953.7 POWER= 8000
 ENEMY FIRES LAZAR
 DIRECT HIT..... POWER DOWN


          STATUS OF SHIP
 RANGE= 151953.7 POWER SUPPLY= 1900
 WHAT ARE YOUR ORDERS JOHN?
 JOHN LETS NOT CRACK UNDER PRESURE
 WHAT ARE YOUR ORDERS JOHN? 4
 ENEMY SHIP REPORT
 RANGE= 116797.3 POWER= 7000
 ENEMY FIRES LAZAR
 DIRECT HIT..... POWER DOWN


          STATUS OF SHIP
 RANGE= 116797.3 POWER SUPPLY=-1200
 ENEMY IS VICTOR
   LIFE SUPPORT FADING
      CREW DYING
```





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Index to Advertisers

Advanced Microcomputer Products	82
Associated Electronic Co.	55
Byte Shops	35
Byte Shop of Pasadena	39
Computalker Consultants	103
Computer Corner	121
Computer Enterprises	121
Computer Mart of New Jersey	27
Computer Mart of New York	121
Creative Computing	65-80
Cromemco	1
Datasearch	1
Dilithium Press	95
E&L Instruments, Inc.	19
Four Corners Press	121
Health Co.	58, 59, 60, 61
Integrated Circuits Unlimited	84
Interface (SCCS)	115
Journal of Irreproducible Results	90
Logical Services	121
Matrix Publishers	7
McGraw-Hill	25
Midwest Scientific Instruments, Inc.	21
Miniterm Associates	4, 5
MITS	CIV
Motorola Semiconductor Products	13
OK Machine & Tool	33, 125
Parasitic Engineering	113
Personal Computing Fair 77	85, 86
Personal Computing Expo	117
Polymorphic Systems	CIII
Processor Technology	15
Scelbi Computer Consulting	11
Scientific Research	2
Seals	8
Southwest Technical Products Co.	CII
Tarbell Electronics	113
Telesensory Systems Inc.	17
University Microfilms	90
VAMP	121
Vector Graphics Inc.	7

Coming in September

- **A Comparison of Software Systems.** Here is the beginning of our information-packed reviews of system software, with Steve North's "Review of Five Small Interpreters, "including CASUAL, Palo Alto Tiny BASIC, Cromemco Control BASIC, Processor Technology 5K BASIC, and MITS 4K BASIC 4.0. This is followed by Geoffrey Chase's timing test on five compilers, complete with listings and a run.
- **The Pocket Computer is (Almost) Here.** Author Richard Ahern describes the research going on in semiconductor laboratories on battery-powered, pocket-sized general-purpose computers that can access up to 13 million bytes in a microcassette, and show up to 378 characters on a low-power 2½ x 2½-inch display.
- **ARTSPEAK.** This specialized computer language provides graphic output, and the author provides some fascinating examples of art generated by simple commands.
- **Games, Games, Games.** Several new ones you'll want to get up and running on your rig right away. Complete listings, runs and descriptions, naturally.
- **Some Tips on Using a TV Set for Computer Output.** You've got a new computer, but no video monitor, so what do you do? Dave Ahl describes the three choices: modify a standard TV set, buy a TV monitor, or build (or buy) an RF modulator, and he gives helpful where-to and how-to information on all three.
- **World Model Bibliography.** Large-scale dynamic global models have predicted everything from doomsday by 2050 to complete equilibrium. On a smaller scale, models tend to be more consistent and hence more useful. The models are getting better and there's an increasing exchange of information between rival groups. Here's an annotated bibliography of ten sources, of interest to people involved with global modelling.
- **An 8-Hour Course in BASIC: Part 2.** If you've read part 1 in this issue, you'll want to continue with this introduction to BASIC by Tom Dwyer, author of "A Guided Tour to Computer Programming in BASIC," one of the best-sellers on the Creative Computing book list.

The POLY 88 Microcomputer System

PolyMorphic Systems now offers the complete, assembled, personal computer system—the POLY 88 System 16. A full 16K system with high speed video display, alphanumeric keyboard, and cassette program storage. A BASIC software package providing the most advanced features available in the personal computing market. Features like PLOT and TIME, which utilize our video graphics and real-time clock. Others like VERIFY, so that you know your tape is good before you load another. Or input type-ahead so you can tell your program to run while the tape is still loading (it stores up to 64 characters of commands or question responses to be executed). All these plus a complete package of scientific functions, formatting options, and string capabilities. With the POLY 88 System 16 you can amaze your timesharing friends the very first night!

Polymorphic Systems 11K BASIC — Size: 11K bytes.

Scientific Functions: Sine, cosine, log, exponential, square root, random number, x to the y power.
Formatted Output • Multi-line Function Definition • String Manipulation and String Functions • Real-Time Clock • Point-Plotting on Video Display • Array dimensions limited by memory • Cassette Save and Load of Named Programs • Multiple Statements per Line • Renumber • Memory Load and Store • 8080 Input and Output • If Then Else • Input type-ahead.

Commands: RUN, LIST, SCR, CLEAR, REN, CONTINUE
Statements: LET, IF, THEN, ELSE, FOR, NEXT, GOTO, ON, EXIT, STOP, END, REM, READ, DATA, RESTORE, INPUT, GOSUB, RETURN, PRINT, POKE, OUT.
Built in Functions: FREE, ABS, SGN, INT, LEN, CHR$, VAL, STR$, ASC, SIN, COS, RND, LOG, TIME, WAIT, EXP, SQRT, CALL, PEEK, INP, PLOT.

Systems Available. The POLY 88 is available in either kit or assembled form. It is suggested that kits be attempted only be persons familiar with digital circuitry.

System 2: is a kit consisting of the POLY 88 chassis, CPU, video circuit card, and cassette interface. Requires keyboard, TV monitor, and cassette recorder for operation. $735

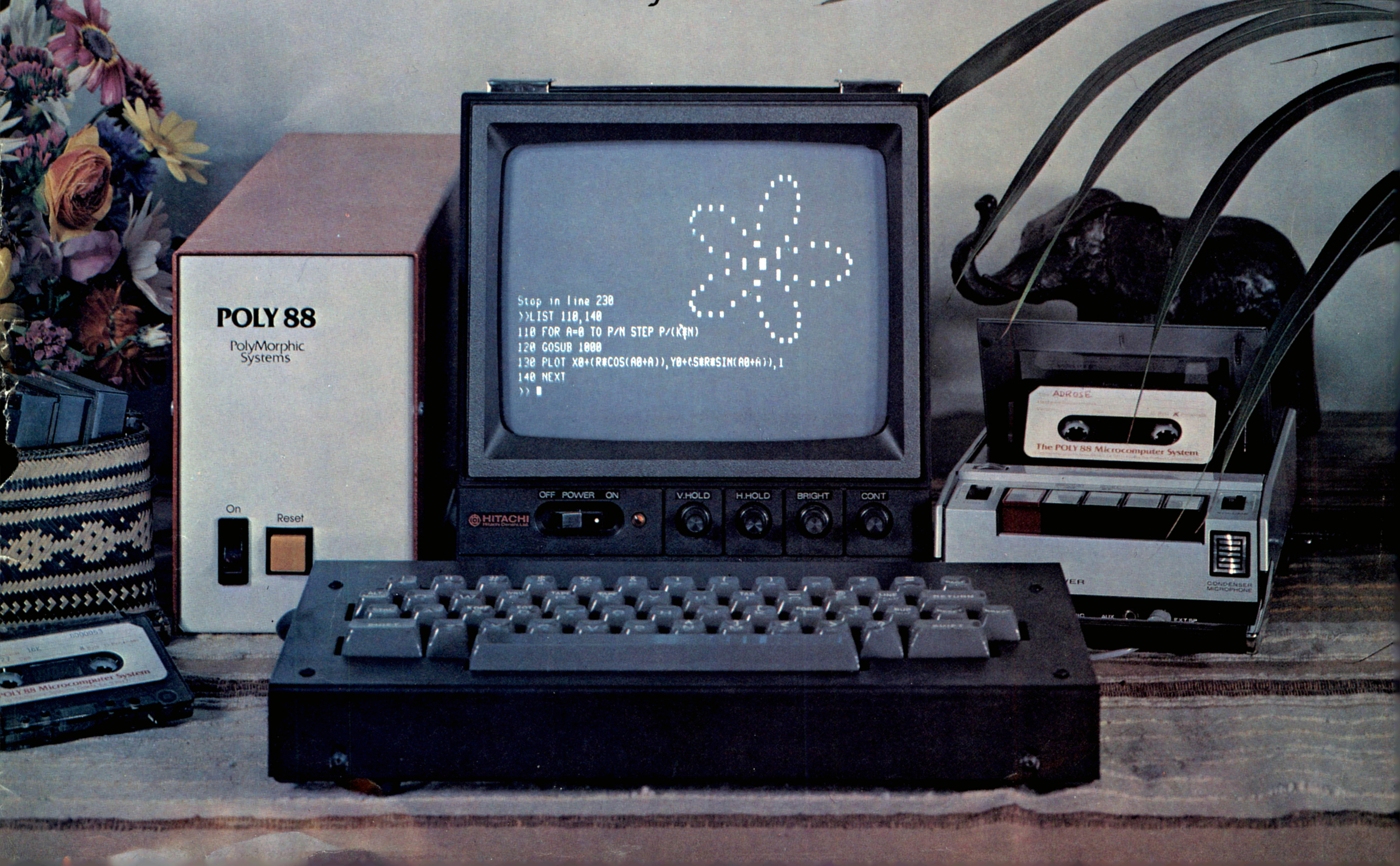
System 16: consists of an assembled and tested System 2 with 16K of memory, keyboard, TV monitor, cassette recorder, 11K BASIC and Assembler on cassette tapes. $2250.

System 0: The circuit cards an S-100 mainframe owner needs to be compatible with the POLY 88 software library. System 0 consists of the central processor card with monitor ROM, the video circuit card, and cassette interface, all in kit form. $525.

Prices and specifications are subject to change without notice.
California residents add 6% sales tax.

460 Ward Drive
Santa Barbara, Ca. 93111
(805) 967-2351

PolyMorphic
Systems



```
Stop in line 230
>>LIST 110,140
110 FOR A=0 TO P/N STEP P/(K*N)
120 GOSUB 1000
130 PLOT X0+(R*COS(A0+A)),Y0+(S*R*SIN(A0+A)),1
140 NEXT
>> █
```

/ability.

It Comes Naturally With The Altair™ 8800b

The Altair 8800b from MITS: the second generation design of the microcomputer that started it all. The mainframe that has the abilities everyone is demanding from microcomputers today:

Expand-ability:

The Altair 8800b power supply and one-piece, 18-slot motherboard allow efficient and easy expandability for memory and I/O options. All Altair PC boards are designed to give you maximum capability/lowest power usage possible per board. This means that for each slot used you get more features and require less power, than with any of the "off-brand" Altair-bus-compatible boards.

Whether you buy an entire system up front or choose to expand gradually, it's easy to get the configuration you need with the complete family of Altair peripheral equipment, including floppy disk, line printer, audio cassette record interface, A/D converter, PROM programmer, serial and parallel I/O boards, choice of four different memory boards and many others.

Reli-ability:

The unique design features of the Altair 8800b, which have set the standard for the microcomputer industry, make it the most reliable unit of its kind. The Altair 100-pin bus, the now-standard design used by many imitators, has been "standard" all along at MITS. The unique Front Panel Interface Board on the Altair 8800b isolates and filters front panel noise before it can be transmitted to the bus. The all-new CPU board utilizes the 8080A microprocessor, Intel 8224 clock generator and 8216 bus drivers.

Flex-ability:

Meeting the diversified demands of an ever-increasing microprocessor market requires flexibility: not just hardware flexibility but software flexibility as well. MITS software, including the innovative Altair BASIC language, allows the full potential of the Altair 8800b computer to be realized.

8K ALTAIR BASIC has facilities for variable length strings with LEFT$, RIGHT$, and MID$ functions, a concatenation operator, and VAL AND STR$ functions to convert between strings and numbers.

Extended ALTAIR BASIC allows integer, single and double precision variables, automatic line numbering and renumbering, user-defined string functions, PRINT USING for formatted output and a powerful EDIT command for editing program files during or after entry. Extended statements and commands include IF . . . THEN . . . ELSE, LIST and DELETE program lines, SWAP variables and Trace On and Off for debugging.

Disk ALTAIR BASIC has all the features of Extended BASIC with the additional capability to maintain sequential and random access disk files. Utilities are provided for formatting disks and printing directories.

In all versions of ALTAIR BASIC you get the ease and efficiency of BASIC for the solution of real world problems.

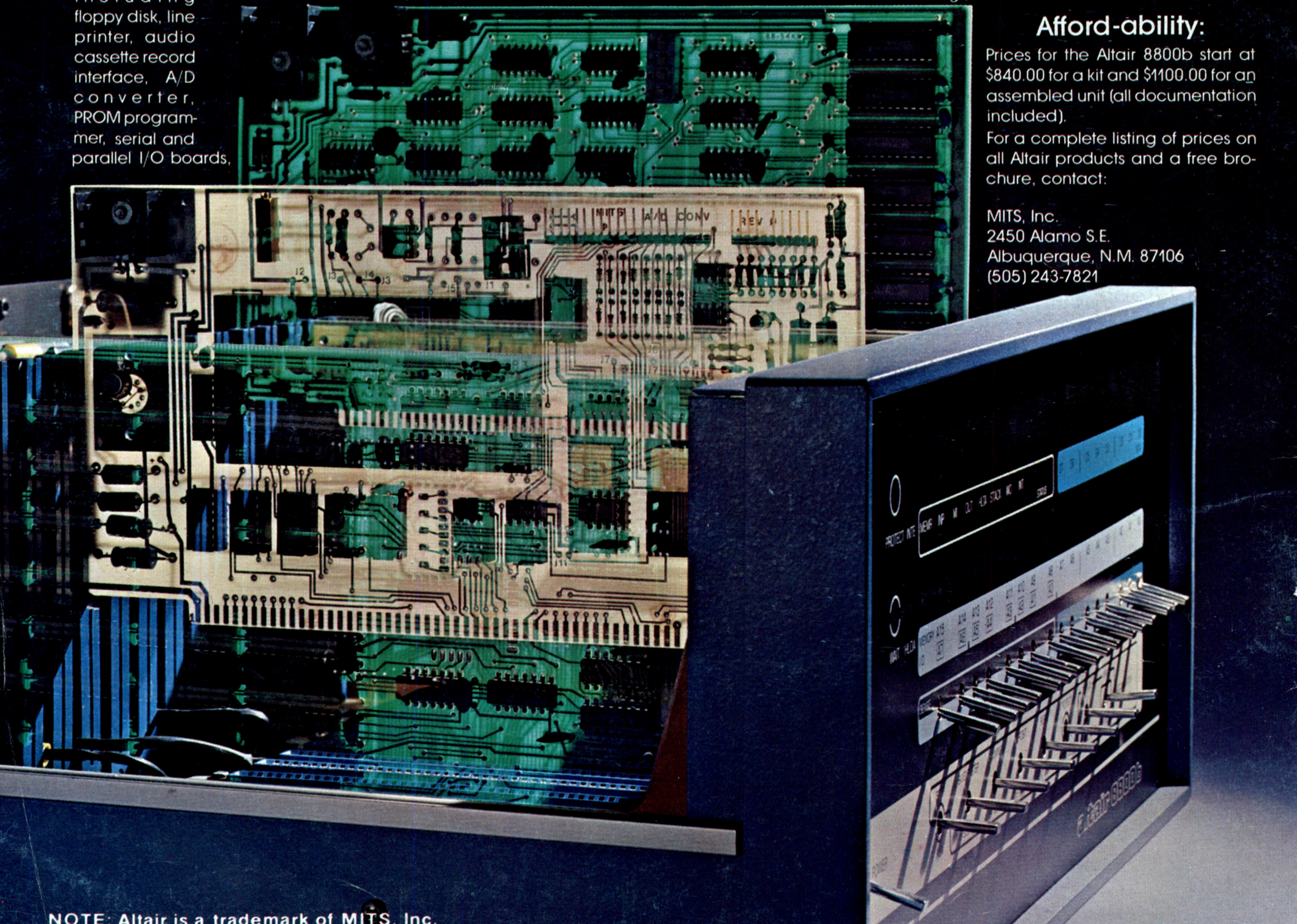
Package II, an assembly language development system for the Altair 8800b, includes system monitor, text editor, assembler and debug.

Afford-ability:

Prices for the Altair 8800b start at $840.00 for a kit and $1100.00 for an assembled unit (all documentation included).

For a complete listing of prices on all Altair products and a free brochure, contact:

MITS, Inc.
2450 Alamo S.E.
Albuquerque, N.M. 87106
(505) 243-7821



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